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In this Issue:

The Russian Enigma

The Layman is Amazed : Airline Financial Results

Boeing XB-47 "Stratojet" — McDonnell "Little Henry" — Saunders-Roe SR-45

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Wind-tunnel model of the Boeing XB-47 (cf. page 74)

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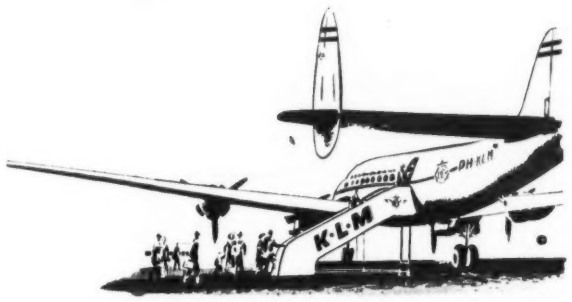

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Tyrone Power, Cesar Romero and Director Henry King

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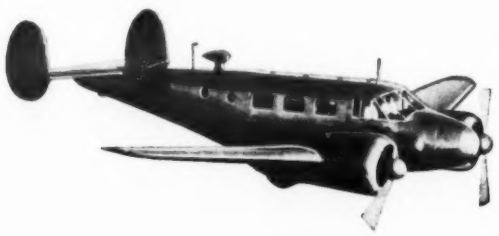

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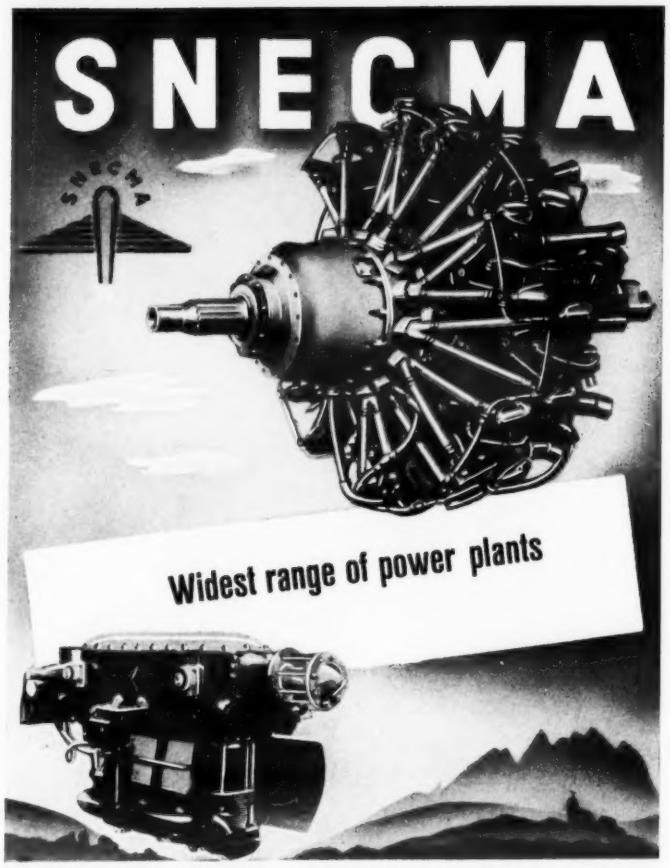

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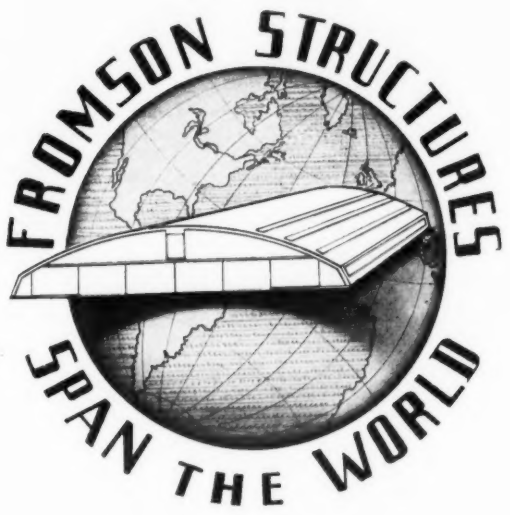

Vice-President in Charge of a Safe Smooth Flight

Besides the pilot and copilot, there's a third man in the *Constellation* cockpit. He is the flight engineer—a man who might also be known as the Vice-President in Charge of a Safe, Smooth Flight.

His contributions to the passengers' comfort and security are both direct and indirect.

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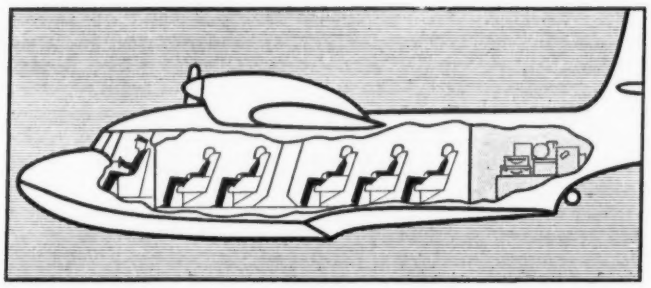

A pretty curve

One of the prettiest curves we have seen for some time is the efficiency curve for the Short Sealand, reliably powered by two 330 h.p. Gipsy Queen 70's. The estimated performance figures for this amphibian make interesting reading. For example, the range, at 127 m.p.h., is 776 statute miles, with full tanks (120 gallons) and 926 lbs. of freight: with 54 gallons of fuel the Sealand takes up to 1,400 lbs. of payload, which is roughly equivalent to seven passengers and baggage—even so, the range is 305 statute miles.

FLYING BOAT PERSONALITIES

Capt. H.W. C. Alger

Manager No. 4 Line, B.O.A.C.

Captain Alger, who is Master Pilot No. 11, did the first of his 14,000 hours on an Avro 504K. He served in the R.A.F. from 1922-1928 and joined Imperial Airways in March '28 with the rank of Captain. In February 1948, Captain Alger will have served 20 years with Imperial Airways and its successor, B.O.A.C., mostly in flying boats.

In many "uneventful" years' flying, one of Captain Alger's chief contributions in his sphere has been the carrying out of experimental and inaugural flying-boat flights on the mail-runs from Britain to Australia, the East and Africa. In 1943, in recognition of a most valuable career, he received the "Commendation for Valuable Services in the Air," in the King's Birthday Honours.

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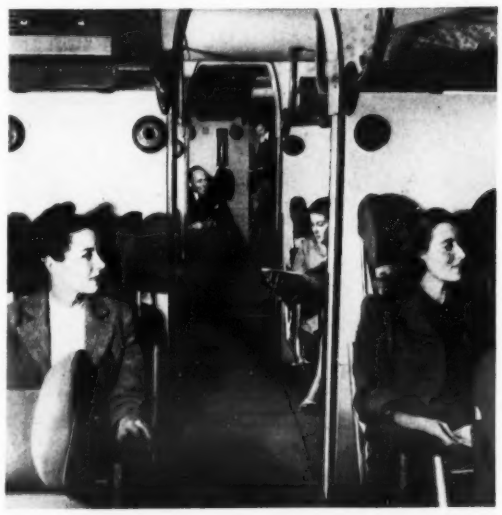

The roomy interior of the Sealand, showing the comfortable seating arrangements

News of the Solent

The Solent, latest Short air-luxury flying boat, is completing fitting-out for B.O.A.C. An illuminating comment on the trend to flying-boats is the fact that Tasman Empire Airways have ordered four Solents for the rigorous Tasman crossing.

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Marginal Notes

German Hopes

In Germany today, an observer gathers the impression that public interest in aviation has disappeared entirely.

The average German regards civil aviation either as a stage property for conferences or a device for transporting German GI-brides to America. Personal worries often seem to have extinguished every memory of flying.

Those who used to belong to the Luftwaffe still show a keen interest in the scanty aviation news featured by the German press, but the majority of them have understood the clauses in the Potsdam Agreement prohibiting any kind of aeronautical activity, and have adapted themselves accordingly. In any case these men have been scattered all over the country, and this alone suffices to make them a factor that is no longer of any significance.

The personnel of the former German Lufthansa are in a rather different position. Particularly in the British and American Zones of Occupation, they seem to be fostering certain hopes with regard to sowing the seeds of a new German commercial air transport system. The fact that foreign companies have made a start by operating commercial routes over German territory—from which, perhaps before long, a small "bizonal traffic network," including Berlin, may arise—has strengthened the grounds of these hopes. Similarly, the announcement that air travel is to be made available again to Germans, has also helped to further these hopes. And it is rumoured that former prominent officials of the Lufthansa sounded the military governments some time ago. If what one hears in this connection is true, then the idea of discussing the possibilities of a future German airline network—premature as this may be—should not be rejected out of hand.

Now that foreign airline companies have already started operating services over German territory, using only purely civil airfields, there are already a few bridges across this former empty air space. And it clearly proves that a "blank space on the European air route map" is absurd, and that nobody wants it either. But if, in the present circumstances, air services for civilian travellers inside Germany and abroad have any significance, how much greater importance would they assume by the time healthy economic conditions had been re-established in Europe.

This is the foundation on which the German hopes with regard to aviation are based. From the outset, however, it must be clearly recognised that they also involve raising a number of questions of principle relative to the Potsdam Agreement. And these questions can only be finally settled by a future peace treaty.

There would be various ways of incorporating Germany, or a part of German territory, in the European air route network, without sowing the seeds of future military rearmament, as was the case after the first World War.

It would be possible for all airline traffic touching German soil, including the services inside Germany, to be operated by foreign companies. In this case the necessary ground services could be run by German private or state enterprise. The Control Council regulation forbidding direction-finding and radar installations in Germany need not be an obstacle, since future aerial navigation will very probably no longer need them but will rely on radio beacons. These are intended for giving aircraft their bearings from the ground, and so can hardly be used for purely military purposes or be described as war equipment.

The main difficulty would be the question of financing such purely German ground installations, since the equipment would have to be supplied and supplemented from abroad. It would be an exceedingly long time before Germany could raise the necessary foreign currency. It might therefore be imagined that interested foreign companies would erect and equip the airfields on a pool basis, which would be operated by German personnel only, at the expense of Germany.

Hopes of realising the alternative possibility could only be entertained by wild optimists. It is the development by Germany of an air transport system of her own. Even if it should evolve into a few inland routes and not many connections with abroad, the difficulty of providing foreign flying equipment would continue for a long time. And in any case, such expenditure would hardly be justified before the most urgent imports in food and raw materials had been obtained.

Whatever may come of civil aviation in and over Germany, there is one factor that stands out illuminatingly. Many of those who used to be engaged in commercial aviation, think or hope that one day they will again be able to resume the profession to which they are no less devoted than any other airfarer, regardless of what nationality.

It is hardly to be supposed that other aspirations are connected with such wishes and hopes—nor that they will be for a long time to come. The greatly abused conception of "*Luftgeltung*"—air power—has been burst like a soap bubble, together with many similar illusions. Nowadays only those who are really crazy about flying cherish such hopes. And these people do not care about the conditions, or even the flag, under which commercial aviation is to be pursued in Germany, provided they themselves are in the game. As a matter of fact, it is not improbable that a few former Lufthansa people are already in the service of the airline companies operating in Germany.

Of course, everything which has started or is about to start in the way of commercial aviation in Germany is coupled with the Western Zones. From this point of view the Eastern Zone is dead and has little to look forward to. But it cannot be overlooked that civil aviation was revived in Hungary some time ago and that the Prague—Berlin route, operated by a Czech company, crosses the Russian Zone, so that a beginning has been made.

A few too clever ones may read something between the above lines which does not exist there, and infer that this is a *ballon d'essai,* or even that this article has been commissioned. Such people are beyond either advice or help. They have dragged us into one war already.

They were not the least among those who helped Hitler into office ; they were the people who refused the democratic Bruening so much as a crumb and later, both before and after Munich, served Hitler whole banquets on silver platters. They were the people who protested, verbally, against German rearmament, but behind the scenes supplied fat Goering with Rolls-Royce engines, although this was prohibited by a gentlemen's agreement with the French.

Today it is of the utmost importance not to deepen the European chaos which a wretched Austrian lance-corporal promised in the event of his defeat. This is the meaning of the Marshall Plan and we are of the opinion that it is time to draw up a balance sheet, cut our losses, and start a new account. Courage and magnanimity are needed for this task.

One can understand Germany's neighbours hating the "Boche" who ran amok and caused them irreparable harm. But what can be done about it ? You can stop somebody eating, drinking, sleeping or reading, but as long as he breathes and lives you cannot stop him thinking. Probably numbers of Germans in the Western and the Eastern Zones are given to thought today. It is the trend and the manner of their thinking that can be influenced.

It happened that one forbade Germany to engage in powered flying, and thus in all innocence created gliding, which was later to become the seed of rearmament and Nazi domination. Germans were forbidden to use their overseas airports, so they evolved the idea of floating airports in the form of catapults. Efforts are being made today to rescue Western civilization, but it is forgotten that civil aviation over Germany is a part of this civilization. Let no one foster illusions—one day it will take shape again, somehow, sometime and . . . somewhere.

EEH.

The Russian Enigma

In many ways the Soviet Union is ahead of the Western Powers in the field of aeronautical science," declared Air Marshal Vershinin, Commander-in-Chief of the Soviet Air Force, on 3rd August, 1947, Air Force Day, in Moscow.

This statement, evidently intended just as much for abroad as for the staff officers who were listening to his address, once more set the incredulous "Westerners" guessing. As usual, opinions, judgments and estimates were as divergent as political partisanship allowed.

It is not yet seven years since a head of state and his entire intelligence staff made a mistake as to the productive capacity of this often underrated country. The expression "land of unlimited possibilities" was coined for the United States of America. What about Russia ?

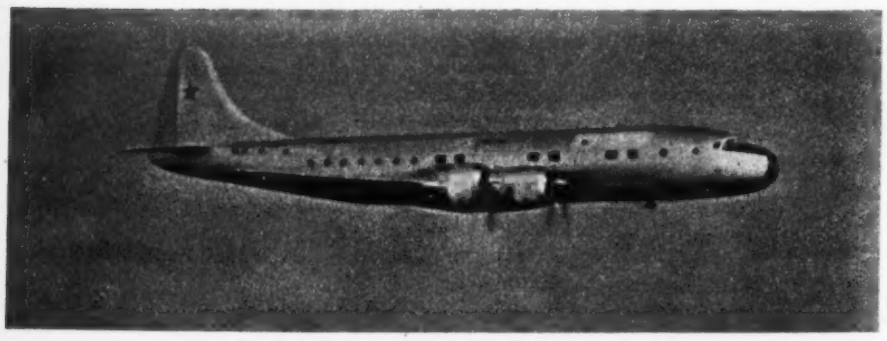
Soviet Russia has crept into her shell more than ever. True, her representatives tour the countries of the West with open eyes and ears. They invariably speak the languages of these countries, but can only be spoken to through interpreters and, curiously, are very seldom inclined to understand questions that foreigners might choose to put to them.

Now there was a time when this same West was visited by numerous delegates and students of another, equally inscrutable race. Small and agile, always smiling, but modest and unobtrusive, the Japanese extracted from Europe and America the knowledge with which they subsequently built up their aircraft industry. But Japan's example gives emphasis to one point : aeronautics is such a young science that our knowledge of it is limited in nearly every field and that fresh discoveries are made almost every day. This was true prior to the second World War and today it applies more than ever before.

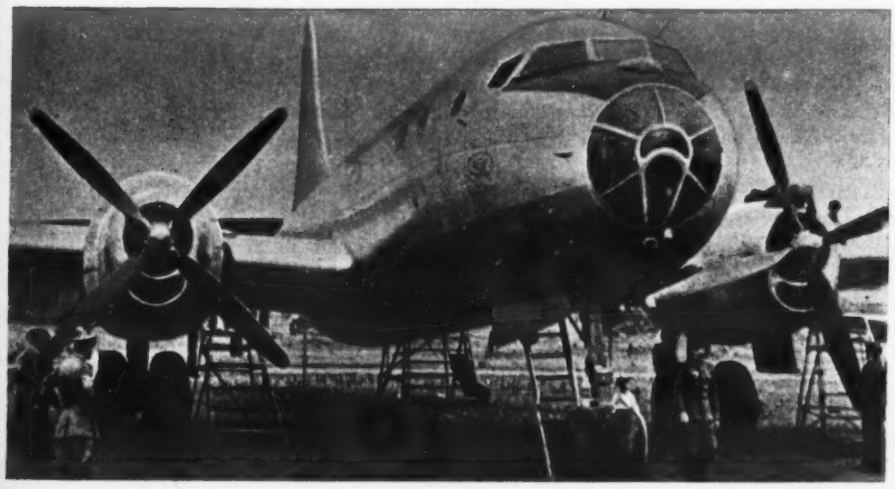
An aircraft industry that does practically nothing else but copy and improve foreign types, evaluating all the research results it can manage to lay its hands on, cannot hope to attain the standards of its teachers, either in quality or speed of production. As an aeroplane which has been copied more or less exactly can but seldom, in spite of improvements and changes, attain, let alone surpass, the performance of the original version, its quality, and consequently its fighting power, must necessarily be inferior to that of the foreign type. The decisive factor is, however, that such aircraft are always obsolete when compared with the products of creative foreign firms.

At the present time the U.S.S.R. is in a far happier position than Japan was in the inter-war period. During the second World War the Soviet Union was able, with Allied help, to build up an industry the capacity of which only a few people can estimate rightly. But far more significant is the fact that far the greatest part of the former German aeronautical industry fell into Russian hands. It is well-known today that a great number of really new jet aircraft, with absolutely up-to-date armament, was ready for completion or under test when the War ended. Only two of the last German production types went into action and became generally known : the Messerschmitt Me 163 and Me 262. But plans worked out by Arado, Blohm & Voss, Dornier, Focke-Wulf, Heinkel, Henschel, Junkers, etc., became Russian property. The War was hardly ended when more or less fantastic figures began to be handed round about serial production of the latest German aircraft types in the Russian-occupied Zone, or, according to a popular phrase, "beyond the Urals." But at the same time one heard of incidents, alleged deportations of technical personnel with special knowledge of these aircraft, and similar occurrences, which were supposed to prove the difficulties encountered by Russia in carrying out her production plans. We will not investigate here as to how these matters really stand : we are no more capable of doing so than any one else. However, it is not without an interest of its own to point out a certain analogy between the Japan of former days and the Soviet Union of today.

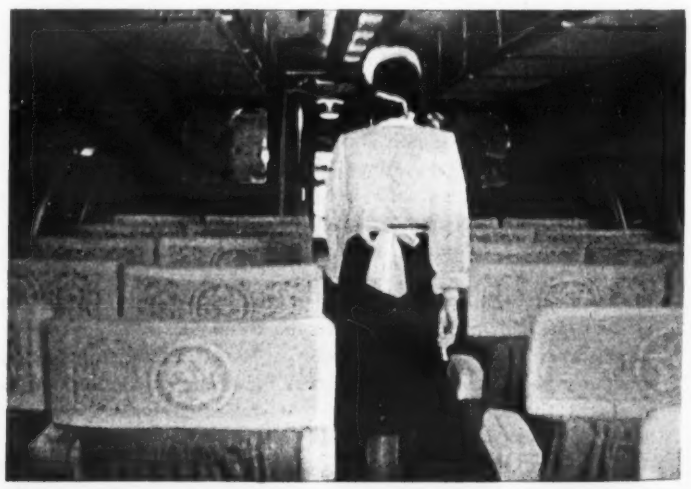
A new Soviet airliner for 72 passengers, the TU-70.



Apart from the low-wing configuration, this picture shows the remarkable resemblance of the TU-70 to the American Boeing B-29.



Front passenger cabin of the TU-70.



Fighter with twin-row radial and additional rocket engine, probably a Walter type, in the stern.

Single-seater fighter with piston engine and airscrew. Additional rocket units are slung under the wings.

The public exhibition of the new Soviet flying equipment on the 1947 Air Force Day evoked mixed feelings among foreign guests. Understandably, they were mainly interested in seeing jet and rocket planes, and several new models did in fact take part in the fly-past. But those who believed that they would see old acquaintances like the Messerschmitt Me 262 or the Me 163, or whole groups of six-engined Junkers Ju 390 bombers, were mistaken.

Some pictures of the new aircraft, as issued by Russian propaganda centres, have been reproduced here as well as possible. In the first place there is a four-engined airliner designated TU-70, of which the designing is attributed to *A.N. Tupolev,* although hitherto his designs have always borne the designation ANT. As was to be expected, the data on this model are sparse. Intended for accommodating 72 passengers in two compartments, the TU-70, in spite of its low-wing configuration, is surprisingly reminiscent of the American Boeing B-29 bomber. The fact that a transparent nose-section is visible on this commercial transport—*honi soit qui mal y pense*—could perhaps be attributed to an oversight on the part of the Moscow censorship. Meanwhile, the side windows in the fuselage and the form of the cockpit lead to the conclusion that the TU-70, in spite of its similarity to the B-29, is *not* equipped with a pressurised cabin. Another picture showing the front cabin is interesting, not so much because of the antimacassars, nor the luggage rack reminiscent of the subway, as owing to the "attractive uniform" of the stewardess.

It is well-known that the Russian army of occupation had the opportunity of acquiring all the documents, tools and machinery necessary for building Junkers Jumo 004 and BMW 003 gas turbines, as well as the Walter rocket engine. It is therefore no wonder that the Russians are trying to improve their own models by combining them with foreign types, just as the Japanese did before them. One of our pictures shows such a combination of East and West, a single-seater fighter powered with a twin-row radial and a rocket engine in the fuselage rear, which resembles, externally, the MIG 5 designed by *Mikoyan.* Another model with radial engine also has auxiliary jet units mounted under the wing, presumably Walter rocket engines. A more modern construction, in which the airframe of a conventional fighter has been taken over unchanged, is attributed to the well-known designer, *Lavotchkin.* The two Techelomey turbines—are they copies of the BMW 003 ?—mounted side-by-side give this low-wing monoplane the appearance of a mid-wing design when viewed from the front. The jet nozzles are at the level of the wing trailing edge and have small crossed vanes mounted in the orifice. Two cannon are fixed beneath the nose of the fuselage and above them, in the centre, can be seen the pitot tube.

A twin-engined helicopter, known as the "Omega" and designed by *Bratuchin,* has two nine-cylinder radial engines mounted on framework outriggers. To judge by the picture, power transmission seems to be via a bevel gear and vertical shaft direct to the rotor shaft.

None of the aeroplanes in these illustrations is really a new model, comparable with the latest constructions in the West. There is no indication that Russian aircraft constructors are achieving any success with regard to piercing the sonic barrier. There is no evidence of high-speed aerofoils, sweepback, etc. Nevertheless the Soviet news agency published the report recently that Russian airmen had flown at sonic speed. The enigma begins over again : on the one hand copies of foreign models and the application of new jet power plants, together with a demonstration of aircraft two or three years behind Western standards ; on the other, the announcement that Western speed records have long been surpassed. The two are not mutually exclusive, however. There existed several German designs for supersonic aircraft, some of which were nearly ready to take the air, and the plans of Lippisch for further development of the Me 163 contained plenty of indications. Even if such a model, with or without the help of German specialists, did really cross the sonic barrier, there is all the same a wide gap between an isolated achievement of this kind and large-scale production. It does not change the picture if Russia has, as the Americans believe, the greatest aircraft production of any State, a yearly output of 100,000 aeroplanes (1947), and an air force equipment of 40,000 aircraft. In fact, this only makes the absence of any sign of really new production since the middle of 1945 all the more conspicuous.

Bi

Jet fighter with two turbines under the fuselage : air intake in the nose of the fuselage ; jet nozzles, with vanes, at the level of the trailing edge.

The "Omega," a Russian twin-engined helicopter designed by Bratuchin.

Boeing XB-47

MODEL TESTS: Several models on different scales were built for investigating the XB-47's drag and stability characteristics. As for the full-scale version, great importance was attached to as smooth a surface-finish as possible (the front cover of this magazine shows the wind-tunnel installation of a model with a span of over six feet).

In the middle of January President Truman's Air Policy Commission laid down the fundamental principles of American armament during the next five years. It recommended that atomic, bacteriological and general scientific research should be promoted by every means; at the same time the *Air Force, the future foundation of the entire American defence system, should be developed to the highest possible standard.*

Neither the aircraft industry nor the officers responsible for materiel procurement had waited for this recommendation. In the

THE XB-47 HAS TAKEN OFF! Four thick plumes of smoke trail from the turbo-jet engines, working at full speed. The aircraft climbs slowly; undercarriage and flaps are visible.

AT 100 FEET: The undercarriage is not yet retracted, the slot between wing and flap is becoming visible. The smoke given out by the turbines decreases with acceleration.

THE PORT SLAT is extended, the pilot begins to climb. The two main landing wheels under the fuselage are retracted forwards; the bomb-hatch is located between them. There are two flaps on either side of the fuselage, the inboard one having a wider chord.

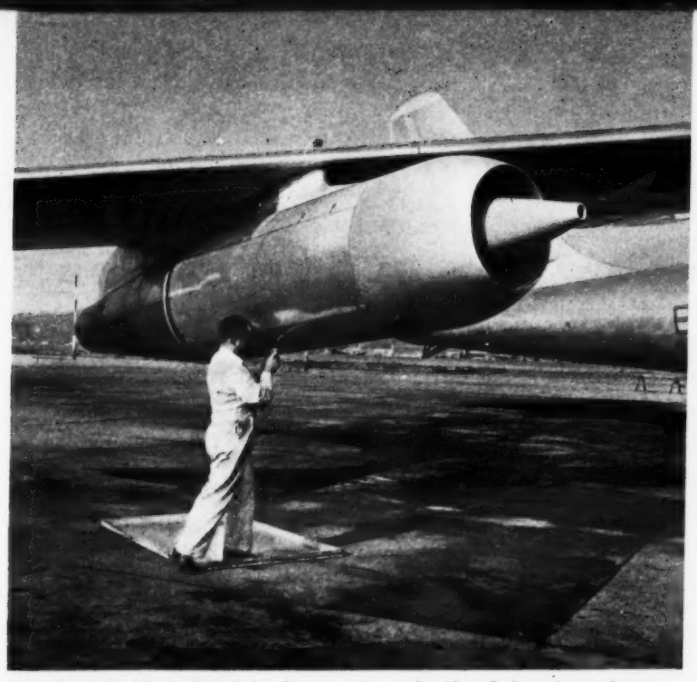
course of the last few years, several U.S. aircraft manufacturers have evolved fighter and bomber types that differ quite considerably from the conventional designs of the war years. These aircraft bear witness to the efforts being made by the U.S. industry to make the best use of experience gained during the War, and particularly of the research data collected in Europe and the U.S.A. in the last few years.

One of these new bombers, the *XB-47* "*Stratojet*," first became known on 12th September, 1947, when its prototype was rolled out of the Boeing Aircraft Company's assembly shop at Seattle, Washington. It is not the first six-engined jet aeroplane to be unveiled to the public by the U.S. aircraft manufacturing industry, and the fact that the "Stratojet" evoked unusual interest is probably attributable to its novel configuration. Undoubtedly, this model represents the transition from the former B-17, B-29 or B-50 bombers to those designs which will be necessary in future when approaching the sonic barrier. For the present it is hardly possible to build bombers with speeds comparable to those of the latest fighters, though this speed differential has all the same been decreasing more and more since the middle of the last war. Since the advent of jet engines, it is not surprising that the lines of new high-performance bombers are beginning to resemble those of fighter aeroplanes.

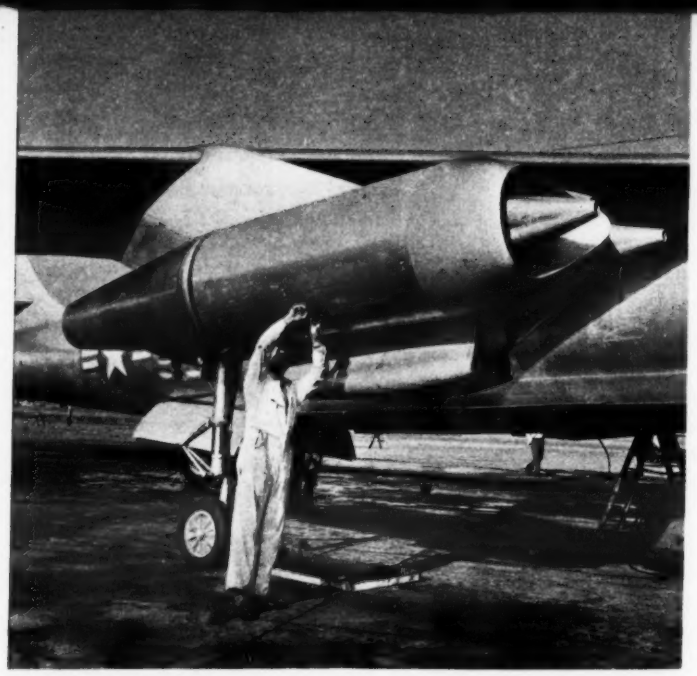
The "Stratojet" is the first large American aeroplane to feature a marked sweepback of about 35 degrees for wing and empennage, and a thin, high-speed aerofoil. Installation of the power plants inside the wing was therefore impossible, so that the six pure jet turbines have been underslung at some distance from the wing's lower surface ; their arrangement is reminiscent of the engine disposition of the last German developments. The inboard nacelles, each containing two engines laid side by side, are mounted almost entirely fore of the leading edge, presumably in the first place for reasons of weight distribution, and are suspended beneath the wing on faired cantilever bearers. Another engine is mounted almost directly against the lower surface of each outer wing, an arrangement which was probably chosen primarily to preserve the necessary safety distance in relation to the ground.

THE JOB IS OVER : Test pilots Robert Robbins (left) and Scott Osler seem pleased with the success of the first flight. Together with a group of more than 50 assistants they are to test the XB-47 during the next few months at Moses Lake Airfield under all kinds of operating conditions. Their work will greatly influence the future development of the XB-47.

THE UNUSUAL DISTANCE between the inboard engine groups and the wing becomes prominent when the bomber is in flight. The slender struts of the supporting wheels are folded forwards so as to lie between the turbines.



THE OUTBOARD TURBINE is close to the underside of the wings: here too efforts have been made to produce an ultra-smooth surface finish, especially at the air inlets. The General Electric J-35 turbo-jet engine develops a maximum thrust of 4,000 lbs. and has a specific fuel consumption of 1.026 lb./lb. hr.



CANTILEVER MEMBERS support the inboard pairs of turbines, between which the upwards-retracting supporting wheels come to lie. The length of the J-35 turbine is 166 ins., its dry weight 2,450 lbs. Immediately aft of the combustion chamber the gases have a temperature of nearly 1,250 degrees Fahrenheit.

The XB-47 has the most powerful jet engines at present produced in the U.S.A. Developed by the Aircraft Gas Turbine Division of General Electric Co. under the designation J-35, they were originally known by the designation TG-130. This engine has an eleven-stage axial compressor and eight cylindrical combustion chambers, 36 $^{3}/_{4}$ inches in diameter. At a speed of 7,700 r.p.m. the J-35 delivers 4,125 lbs. of thrust.

The "Stratojet" is claimed to have a range of 2,000 miles; however, in view of the extremely high fuel consumption of current jet urbines (1.026 lb./lb.hr. for the J-35), the supply of fuel for such a range would be so large that no very great weight in military cargo could be carried. Meanwhile, load-carrying capacity is not the only reason why an aeroplane like the XB-47 cannot have an unlimited quantity of fuel; the volume limit also makes it impossible. As the aerofoil precludes the use of wing tanks, the entire supply is located in the fuselage, of which the centre portion must remain free for the bomb load. As a matter of fact the fuel consumption, according to the above data on the greatest range, would involve a weight of 66,000 lbs., i.e., more than half the aircraft's gross weight of 55 tons. If the bomb load named by the manufacturers were to be carried, i. e. 10 tons, the range would be decreased considerably.

Since, owing to the poor efficiency of pure jet engines at low airspeeds, the power of the six turbines would hardly be enough for the take-off, the XB-47 is provided with a battery of take-off rockets. Their installation is altogether novel, in that the JATO-rockets are not located, as usual, outside the aircraft, but in groups of nine inside the fuselage. Weighing 200 lbs., each of these units can deliver a supplemental thrust of 1,000 lbs.

EIGHTEEN JATO ROCKETS are built into the fuselage in groups of three. The photo shows ignition tests being carried out on the rear group on the port side. Each rocket gives 1,000 lbs. thrust for 14 seconds. The pilot has the choice of using all eighteen units simultaneously, thus obtaining 18,000 lbs. thrust over 14 seconds, or each group of three units successively, which means an auxiliary take-off thrust of 6,000 lbs. during 1 min. 24 seconds. This reserve of propulsive power is not only useful when taking-off with a heavy load, but also allows a pilot to go round again in the case of a misjudged landing.

during 14 seconds. The pilot has the possibility of selecting the duration and magnitude of this auxiliary means of propulsion, by simultaneous or successive ignition of the rockets, singly or in groups. It is obvious that such a reserve of power is an asset to highly-loaded jet aircraft, not only for the take-off, but especially for emergencies such as in the case of a misjudged landing when the pilot decides to go round again : such an aircraft's best climb performance only starts in the vicinity of its greatest horizontal speed.

The lines of the XB-47 remind one of those of a fighter plane, with the result that one tends to underestimate its size. Surprisingly, its gross weight is 30 per cent. more than that of the Douglas DC-6 and its span of 116 feet is only 1 ½ feet less. From the wing area of roughly 1,400 square feet and gross weight of about 125,000 lbs., a wing loading of about 86 lbs. per square foot may be deduced—signifying an extraordinarily high minimum speed for taking-off and landing. To improve these conditions Boeing engineers were compelled to build particularly powerful flaps which could enlarge the wing area considerably. The accompanying illustrations show the arrangement of these two flaps on either side of the fuselage. The inboard flaps have a chord equal to almost one third of that of the wing and the outboard flaps extend as far as the ailerons. In addition to the flaps, the XB-47 has an automatic leading-edge slat extending from the wing tips to the inboard engines.

When the "Stratojet" was rolled out of its hangar on September 12th, very exhaustive taxiing trials began, which lasted nearly two months. This becomes understandable upon close inspection of the new aircraft's landing gear : to the inboard engines are attached comparatively weak supporting wheels, while the pairs of main wheels are housed in tandem inside the fuselage. In the taxiing trials, which took place on the 7,000-foot runway of the Boeing factory airfield, speeds up to 109 m.p.h. were attained and the reliability of the landing gear proved by driving the bomber over bumps and subjecting it to sharp changes of direction.

The first flight was when Robert Robbins and Scott Osler piloted the "Stratojet" about 120 miles to Moses Lake Airfield, which has two 10,000-foot runways. After the initial stages of the flight test programme have been accomplished there, the aircraft will be flown to Muroc Dry Lake for further testing by the U.S. Air Force. *Bi.*

WING AND EMPENNAGE of the XB-47 feature a sweepback of about 35 degrees. According to wind-tunnel tests the critical Mach Number is considerably postponed by this disposition. A top speed of about 630 m.p.h. is expected at 30,000 feet. The only defence armament carried by the XB-47 consists of two remote-controlled large-bore machine guns right in the stern of the fuselage.

A CREW OF THREE MEN is foreseen for the "Stratojet" : pilot, co-pilot and bombardier. The latter's station is in the fuselage nose. All three have ejection seats for baling out at high speeds. For altitude flying the crew's quarters can be pressurised and refrigerated. The co-pilot's station includes complete radar equipment.

THE REAR PAIR OF LANDING WHEELS retracts into the fuselage aft of the bomb-hatch. On both sides of the wheels are comparatively large drums, enabling the high landing speed of the XB-47 to be braked without incurring dangerous overheating of the tyres. The rockets protrude obliquely to the rear through a fire-resistant metal fairing on the fuselage wall. Ignition is accomplished by an automatic selecror.

The Air Hostess Told Us ...

Escapists...

"Book your place in the sun and miss the worst of winter," says the advertisement which Esmeralda, our Favourite Air Hostess, clipped from an English newspaper. "Exchange February for July," it continues, "turn your back on the icy North-East blasts and follow the swallows to Africa's blazing clime . . . Book for the Winter Sunshine Club's next Grand Air Tour . . . In six weeks you travel by modern airliner to Nairobi, the Great Game Reserve, Capetown . . . seeing gold and diamond mines, ancient tribes, modern cities and jungle trails . . ." This, Esmeralda says, makes her weep. She's now working the North Atlantic run where the weather is foul at either end. Probably she is not the only one to weep. We have a suspicion that all those "directed" Englishmen who can't leave their jobs because of the "Control of Engagement Order, 1947" must feel similarly inclined. And even most of those who are exempt would feel distressed upon inserting their finger-tips in the old pocket-book and failing to find the £495 ($1,980) required to finance the junket. (Incidentally, that figure "495" reminds us of the $1.98 or 4/11d. price tags in the department store windows.)

Which shows you that in these dismal times you have to be too old or too rich to work in order to become an escapist — hitherto the privilege of youth. Esmeralda pictures tribes of fat old boys admiring black old tribes, inspecting diamond and gold mines no different from other large holes in the ground, walking through modern cities probably little different from those at home. But, she confesses, she'd still like to go along with the Sunshine Club.

... and fugitives

What you really encounter when you arrive in Africa Esmeralda described upon her return from BOAC's proving flight last December for the proposed flying-boat service from England to Vaaldam, near Johannesburg, South Africa.

The Sunderland boat "Helmsdale" was flying over the Dark Continent — which looks mainly green and yellow — when the captain pointed to a spot of mist fifty miles away and said, that's where we land. The mist was the spray thrown by the Victoria Falls, and the boat alighted on the Zambesi River four miles upstream. Esmeralda grins when she visualises the fat old boys stepping straight into real Africa, firmly expecting the current to break the mooring cable and carry the whole shebang, flying-boat, f. o. b.'s and all, over the Falls. She imagines them trembling even at the possibility of such minor mishaps as falling out of the motor-launches into the crocodile- and hippo-infested water separating the mooring area from the landing stage in the thick jungle. She conceives them sighing with relief upon sinking into the upholstery of the motor-coach taking them along the specially-built road to the Victoria Falls Hotel, a few miles away, only to be frightened out of their wits again by the unscheduled appearance of herds of wild elephants which normally confine their regular depredations of the road to the hours after dark. And she pictures these escapists from the greyness of their dreary rounds scampering from the bus and scuttling into the undergrowth, fugitives from the charms they had come to seek.

The Boon of Progress...

But don't get the impression that African air traffic consists exclusively of whites trying to get quick looks at blacks. The natives, too, have taken to the air. Esmeralda is an authority on the subject.

You know about Ethiopian Airlines, which was organised by men from TWA, who still provide the technical management. The pilots are from the U. S. A., the staff is made up of Ethiopians, Egyptians and Greeks. The line has about ten DC-3's flying from Addis Ababa to Cairo, Aden and other places. About a year ago, Esmeralda and her girl friend Ellen were sent to Addis to instruct hostesses for the line. Ellen taught for six weeks and then she married the Chief Pilot, but Esmeralda stayed on a little while. Ethiopian Airlines' hostesses are mostly Egyptians and Greeks who speak at least four languages. They usually need the lot on each flight, talking to big-game hunters, priests, merchants and pilgrims going to Mecca.

One day an old Arab got on the scheduled Addis Ababa aircraft at Sheikh Othman Airport, Aden.

When the aircraft landed at the Ethiopian capital, the old man simply stayed in his seat. Esmeralda explained to him that he was at his destination, but he just sat and refused to budge. After trying again and again, Esmeralda asked him the reason for his not wanting to get off. Old Abdullah then told her why : every year, he said, he had been making the journey from Aden across the Red Sea to Addis Ababa, 7,000 ft. above sea level, by camel, boat and railroad. Now, by air, the trip took only four hours, whereas previously the journey had taken at least two weeks. Those two weeks gave him ample time to adjust himself to the change and to think what he would do in Addis. But now, after only four hours, he was completely lost . . .

At this point, the station hostess took over, and Esmeralda never knew if old Abdullah finally got off or if he went back to Aden. But, says our Favourite Air Hostess, the tale has a moral. She thinks that the failure of so many recent international conferences may be ascribed to the fact that the delegates usually travel to their meeting places by air. Hence, they may not have time enough to adjust themselves to the different diplomatic climates they encounter or to figure out exactly what they are going to do. Therefore, Esmeralda suggests, Foreign Ministers and minor diplomats should be encouraged to walk to the scenes of conferences. After a dog-trot over hundreds or thousands of miles, most of them would find themselves ready to sign practically any kind of agreement. *Bl.*

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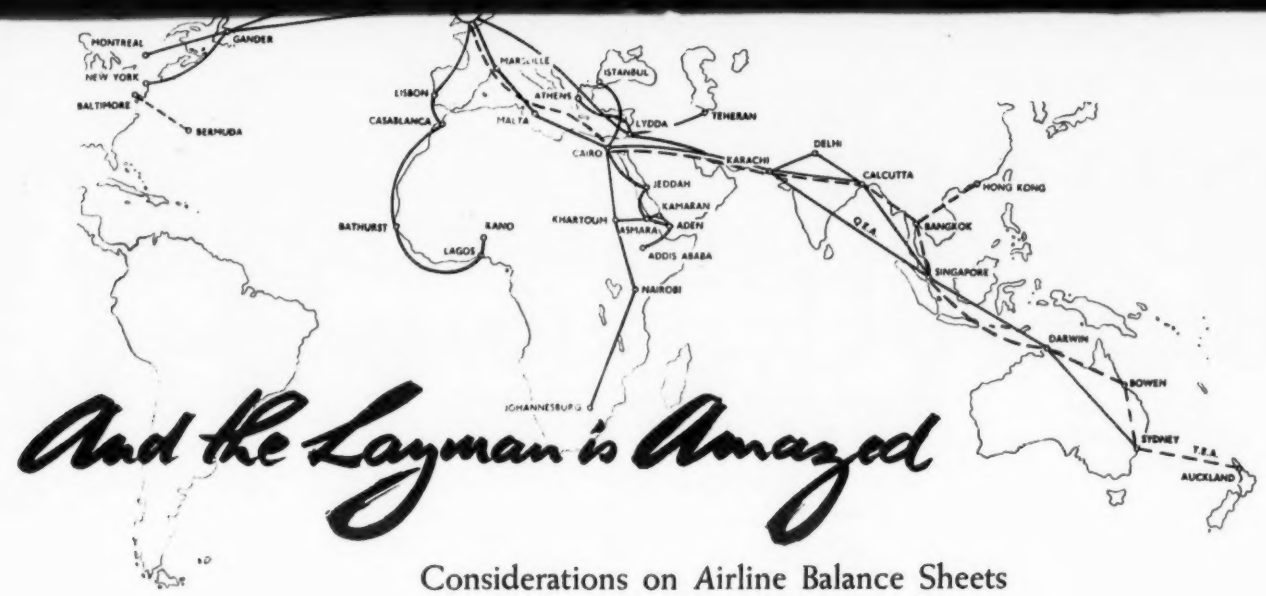


And the Layman is Amazed

Considerations on Airline Balance Sheets

I could not believe my eyes !

Towards the evening I arrived at Croydon from Paris and was met by Charles Roche, who was our representative at the time. I asked him how things were. It was 1930. World economic depression was noticeable everywhere. It had begun on Wall Street, it had reached the coasts of Europe. Over-production of goods was bringing businesses to the verge of collapse.

Charles Roche took me to Trafalgar Square. Nelson was still on his column, venerable streets like Whitehall and Pall Mall had not changed. Externally, London, the centre of the world, seemed to be the same. But on that rounded building where the Strand enters Trafalgar Square two words shone out hugely and brightly—"BUY BRITISH."

What had happened ? The British, who invented Free Trade and founded their Empire on it, were launching propaganda for Protectionism, Nationalism and everything connected with these conceptions.

Believe me, that was when the misfortune started ! The crisis has never stopped since. What has happened since 1930, and is still happening, is its consequence.

You may ask what this has to do with aviation. Wait a minute !

* * *

There are papers on the editor's desk with estimates and statistics relative to the balance sheets, or preliminary balance sheets, of three major European air transport companies. These figures may not be considered in the same light as those in the balance sheets of banks or ordinary industrial concerns, for they contain isolated terms which are unfamiliar to the orthodox economist. A present-day airline company will not, cannot or must not assess certain aspects, partly because there is no yardstick for doing so and partly because their public discussion would not be in the national interest. Air transport today is not merely a branch of the public services, but also a standby in case of war.

Civil aviation reports must therefore be read between the lines, and this can easily lead to errors. Nor can direct comparisons be made between different reports, since the airlines have to take their respective national interests into account.

Meanwhile, however, between the estimated or final balance sheets of *K.L.M. Royal Dutch Airlines, Air France* and of the British airline Corporations, *B.O.A.C., B.E.A.* and *B.S.A.A.*, certain points in common do exist. All these enterprises are officially or semi-officially national property and each flies a worldwide network. Finally, they all endeavour to be self-supporting.

* * *

The estimated operating results obtained in 1947 by K.L.M. Royal Dutch Airlines *refer to the company's 28th fiscal year.*

Although in 1945 the management had to build up again from nothing, so to speak, they were officially unsubsidised again by 1946. However, the expression 'unsubsidised' must not be taken too literally in the case of K.L.M., any more than for other airline companies. The Dutch Treasury backed it up. A law enacted in August, 1947, enables the company to dispose of State funds up to 51,000,000 guilders in order to increase its capital, and of public funds or guarantees up to 50,000,000 guilders for the issue of loans. At present the issued capital can be assessed at 41,500,000 guilders, 97 per cent. of which is State-owned.

By these means K.L.M. was able to assemble flying equipment which at first sight appears to be the most uniform, modern and therefore the most economic of any European company. At the end of 1947 it comprised :

16 four-engined Douglas DC-4's (or C-54's)
17 four-engined Lockheed L-49 (or L-749) "Constellations"
85 twin-engined Douglas DC-3's (or C-47's)
7 four-engined Douglas DC-6's (ordered and about to be delivered).
12 twin-engined "Convair-Liners" (ordered and about to be delivered).

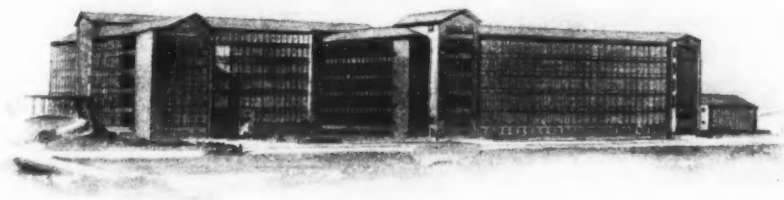
Total : 137 units.

Mr. Albert Plesman, President of K.L.M.

During 1947 K.L.M.'s payroll rose from 6,627 to 11,000 employees, of whom about 900 are flying personnel.

Operating Results.

	1947	*Nine months 1948*
Flying hours	49,996	65,223
Distance flown (kms.)	12,505,412	17,610,209
Route network (kms.)	62,784	104,300
Paying passengers . .	258,782	268,616
Excess luggage (kgs.)	499,999	570,205
Freight (kgs.)	1,323,434	2,703,839
Mail (kgs.)	693.731	1,057,620
Total income (guilders)	68,000.000	94,000,000 (estimated for 12 months)



K.L.M. Head Office, the Hague.

The estimate of a total income of 94,000,000 guilders for 1947, which at the official rate of exchange would amount to about $36,000,000, calls for some comment. It relates on the one hand to an estimated passenger total of 350,000, involving in theory a passenger income of about $100 per head. In view of the company's subsidiary sources of income this calculation is painted in rather rosy colours. Unquestionably, K.L.M. has derived considerable income from Government transport contracts to Indonesia, and furthermore it must have obtained quite a considerable part of its income from technical services rendered to outsiders. It would hardly be wrong to suppose that, in the case of K.L.M., as well as with the other nationalised airlines, the State-owned company capital has been and will remain free of interest. This forms an indirect kind of subsidy and has allowed the enterprise to write off considerable sums for equipment and installations.

Leaving out these qualifications, however, we arrive at a mathematically-defensible conclusion : no loss on the part of the company, no loss per passenger flown.

* * *

The estimated operating results of Air France *relate to the company's 14th fiscal year.*

This enterprise also had to start afresh in 1945, following the Liberation of France.

In 1946 the company worked at a loss amounting to 25 per cent. of its expenditure. In 1947 the loss was reduced to 15 per cent. It will be seen later what this signifies in relation to operating results. Air France also disposed of State funds which enabled it to renovate and standardise its flying equipment. Including some older models used for colonial and mail transport, at the end of 1947 the Air France fleet was as follows :

13	four-engined Lockheed L-49 (or L-749) "Constellations"
15	four-engined Douglas DC-4's (or C-54's)
15	four-engined Bloch 161 "Languedocs"
3	Latécoère 631 six-engined flying-boats
36	twin-engined Douglas DC-3's (or C-47's)
9	twin-engined Lockheed C-60 "Lodestars"
42	three-engined Junkers Ju 52's
2	Consolidated "Catalina" twin-engined flying-boats
135	units.

Chief Engineer Henri Desbruères, Director-General of Air France.

In 1947 the payroll increased to include more than 10,000 employees, of which about 1,000 are flying personnel.

Operating Results

	1946	(Estimated) 1947
Flying hours	—	—
Distance flown (kms.)	23,646,349	32,500,000
Route network (kms.)	152,985	212,595
Paying passengers	297,314	428,000
Freight (kgs.)	5,087,667	7,130,000
Mail (kgs.)	4,195,888	5,030,000
Total income (francs)	2,847,000,000	5,550,000,000 (estimated)

The Air France booking office, Champs-Elysées, Paris.

As already mentioned, the company's expenditure exceeds its income by about 15 per cent., leaving an estimated loss of about 800,000,000 francs or, at the present official exchange rate, $7,000,000. *In contrast to K.L.M., it is improbable that Air France has any concealed secondary earnings on the books, either from military transport contracts or technical services to others, for the 1947 fiscal year. The company's capital, or its State loans, have probably likewise been exempt from any interests, so that it had the means of writing off certain sums for equipment and installations.*

If profit or loss on every passenger transported is worked out in the same way as for K.L.M., the result, taking into account 428,000 passengers and a loss of $7,000,000, is a deficit of about $16.50 per passenger.

* * *

Although the final 1946/47 reports of the two most important British airline Corporations, British Overseas Airways *and* British European Airways *are already available and it is stated that the third Corporation,* British South American Airways, *has operated without loss, the entire picture is more complex and still more impenetrable.*

On the 31st March, 1947, British Overseas Airways Corp. *concluded its first real year of purely civilian and no longer military operating.*

Its capital of £20,000,000 was issued in the form of debentures at an interest of 2½ and 3 per cent. and was guaranteed by the State. The enterprise also has the right to raise its resources, under State guarantee, to £30,000,000.

Whereas K.L.M. and Air France had virtually to rebuild their organisations in 1945, this was not the case with B.O.A.C. It had a legacy from its execution of military transport contracts which was by no means slight with regard to general organisation and, particularly, flying equipment. At the end of March, 1947, the B.O.A.C. fleet comprised :

21	Short four-engined flying-boats
3	Boeing B-314 four-engined flying-boats
5	four-engined Lockheed L-49 "Constellations"
30	four-engined Avro "Yorks"
14	four-engined Avro "Lancastrians"
8	four-engined Handley-Page "Haltons"
39	twin-engined Douglas DC-3's (or C-47's)
6	twin-engined Lockheed C-60 "Lodestars"
132	units
and also : 42	old aircraft of different types loaned by the Air Ministry
Total : 174	units.

The diversity and obsolescence of this equipment are greater than the list shows. Apart from the five "Constellations" they are principally pre-war flying-boats, converted four-engined bomber or transport aircraft, numerous twin-engined de Havilland "Dragon Rapides," Avro "Ansons," etc.

Sir Harold Hartley, Chairman of B.O.A.C.

In March, 1947, the payroll of the company numbered 24,464 employees ; the proportion of flying personnel cannot be ascertained.

Operating Results, 1946-47

Flying Hours	—	—
Distance flown in miles (kms.)	27,537,849	(44,317,500)
Route network in miles (kms.)	53,998	(86,900)
Paying passengers	129,928	
Freight in lbs. (kgs.)	5,800,000	(2,640,000) estimated
Mail in lbs. (kgs.)	6,300,000	(2,850,000) estimated
Total income :	£11,547,000	

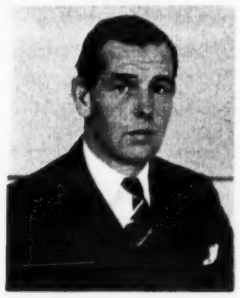
Airways Terminal, London.

This income of £11,547,000 compares with an expenditure of £18,806,000, which means a loss of about £7,250,000. The actual loss, however, is about £8,000,000, or $32,000,000 at the official rate of exchange.

If profit and loss are worked out in relation to the number of passengers transported, in the same way as for K.L.M. and Air France, 129,928 passengers and $32,000,000 loss mean a deficit of about $250 per passenger transported.

* * *

British European Airways *concluded its first fiscal year on March 31st, 1947, covering a period of only eight months.*



Gerard d'Erlanger, Chairman of B.E.A.

The capital of £20,000,000 consists of a loan by Barclay's Bank, guaranteed by the Government. The Corporation has the right to take up further loans up to £20,000,000. Originally the European division of B.O.A.C., B.E.A. acquired the status of an independent Corporation on August 1st, 1946.

At the end of March, 1947, the B. E. A. fleet stood as follows :

29 twin-engined Vickers "Vikings"
22 twin-engined Douglas DC-3's (or C-47's)
45 twin-engined D.H. "Dragon Rapides"
11 three-engined Junkers Ju 52 "Jupiters"
12 twin-engined Avro XIX's
Total : 129 units.

In March, 1947, the company payroll numbered 5,731 employees, the proportion of flying personnel not being ascertainable.

Operating Results, 1946-47 (8 months)

Flying hours	22,753	
Distance flown in miles (kms.)	—	
Route network in miles (kms.)	—	
Paying passengers	72.444	
Freight in lbs. (kgs.)	1,810,000	(820,000)
Mail in lbs. (kgs.)	1,020,000	(463,000)

Total income : £1,206,045

This income of £1,206,045 is confronted by an expenditure of £3,101,000, so that the operating loss works out at about £2,000,000. The real loss, *however, rises to about £2,150,000,* which would amount to £8,600,000 at the official rate of exchange.

If we again calculate profit and loss in relation to the number of passengers transported, as we did for the K.L.M., Air France and B.O.A.C., 73,444 passengers and a loss of $8,600,000 signify a deficit of $120 per passenger flown.

Comparison

	Distance flown in kms.	Route network in kms.	Number of Aircraft	Number of passengers	Loss in $ per passenger
K.L.M.	17,610,209*	104,300	137	350,000	0 (?)
Air France	32,500,000	212,595	135	428,000	$16.50
B.O.A.C.	44,317,500	86,900	174	129,928	$250.00
B.E.A.	—	—	129	72,444	$120.00

* 9 months.

In Great Britain there have been extensive discussions since the publication in December, 1947, of the losses suffered by the national airline Corporations, as to how this phenomenon is to be explained and how it is to be avoided in future.

It is illustrated by questions addressed by a Member in the House of Commons on December 10th to the Parliamentary Secretary to the Ministry of Civil Aviation, Mr. Lindgren.

Mr. William Shepherd, M. P., asked whether it was intended to take delivery of the (6) Boeing "Stratocruisers" in view of the restrictions on foreign travel : when deliveries were then expected to take place and whether the Parliamentary Secretary was satisfied that these planes could be successfully operated.

Mr. Lindgren answered : Yes, Sir. Deliveries of these aircraft are expected to begin in August, 1948. The answer to the last part of the question is also, "Yes, Sir."

Mr. Shepherd : How can the Parliamentary Secretary make that reply in view of the fact that on the East-bound run (North Atlantic) the existing "Constellations" are coming back, in the main, practically empty ; and will he not agree that the purchase of these aircraft is yet another great blunder which his Ministry have committed ?

Mr. Lindgren : Most certainly not. The present operation of the "Constellations" on the North Atlantic service is an economic service, in so far as the relation between the load factor and the operating costs will make it economic.

Mr. Shepherd : Is the Parliamentary Secretary saying that it would have been in the national interests not to have bought "Constellations" instead of "Stratocruisers" ?

Mr. Lindgren : I am saying that at the moment we have no British aircraft which could have been economic in relation to the operating costs and load factor.

Mr. Shepherd : I agree.

Mr. Lindgren : These aircraft are economic and therefore this is the most profitable course to adopt.

* * *

This little interlude of question and answer between an M. P. and the representative of the British Ministry of Civil Aviation cannot have caused the latter much pleasure. The British reader, whether airline director, passenger or simple taxpayer, cannot have read it with much enjoyment either. Now it might be asserted that the blunder is attributable to the contracted firms of aircraft manufacturers. But this is far from the truth.

For—what is the use of phrases ? Such things can be explained perfectly simply if we express ourselves logically and intelligibly.

Buy British—why not ?

If a man attaches particular importance to clothes, and wants a well-cut dress suit, the best thing he can do is to go to a good Savile Row tailor. If you are interested in fine silver, good leather, a real steak, or other things of a luxury nature, you used to get the best in England and will do so again. Certain manufactures, such as Rolls-Royce jet engines or Armstrong-Siddeley airscrew-turbines, or a Rolls-Royce car, cannot be surpassed anywhere in the world. By all means—Buy British.

If your wife likes smart clothes, perfume or other feminine falderals, Paris is the best place to get them.

If you want to become the owner of a watch which keeps good time, you had better buy a Swiss one. If you are fond of Malossol Caviare of the last catch, there is nothing for it but to apply to the Russians.

But if anyone wants to buy a modern, multi-engined, thoroughly-proven and economically-designed airliner, he must go to the specialised production firms in the U.S.A. This was the case before the War, it has not changed since, and it will probably remain so for some time to come.

Now, if the British airline director has to buy his aircraft in Great Britain, interested circles must not reproach him with working less economically than, or not so well as, others. That would be unreasonable and illogical.

It started in 1939 and it is still the same today : buy British, buy Spanish, buy Albanian, buy Peruvian ! But don't complain if world commerce suffers and civil aviation fails to advance. *EEH.*

A Nabob For a Day

It had to happen—I have just made my first flight.

To be quite truthful I received my aerial baptism sixteen years ago, in an open-cockpit air taxi over Le Bourget. It lasted ten minutes. This time I remained literally suspended between Heaven and Earth for a full hour and a half—just nine times as long. If I continue at this rate, taking into account the progress of aviation, the third time I shall be able to make a trip round the world and the fourth time it will be a flight to the moon. As I shall be quite senile by that time it will be quite logical to try and go right through to Heaven.

To return to my adventure. I was in Brussels and there was no convenient train for returning to Paris. I toddled along to the offices of the air transport company. It was packed with travellers bound for France and we were all crammed into a motorcoach and taken to the airport. Upon arrival our names were checked and we made our way to the departure hall. My name was last on the list. I went along in my turn but the official in charge began to wave his arms like a windmill. It's a professional disease, I thought. He imagines that he's an aeroplane.

But this wasn't the case. He was trying to stop my going through. He explained that he was extremely sorry but there had been a mistake and they had taken one booking too many at the office. Furious, I began to curse the air, all the gods of the upper- and underworld, Belgium, France, aeronautics, the United Nations Organisation and humanity in general. My vociferations relieved me to such an extent that, after a while, I found myself feeling almost happy at not having to fly. After all, I wasn't in a hurry, and then, perhaps, I should have been airsick, and the weather wasn't good anyhow . . .

By the time I had firmly convinced myself that the gods had smiled upon me, the official came up to me again.

"You can go after all," he said. "It must be your lucky day."

My guide led me along mysterious routes. "Hush," he said, as we passed a hangar. "The others mustn't see you. You will be the first to leave."

"Look here," I broke out, anxiously, "You aren't planning on using me as a guinea pig for some nefarious experiment, are you ?"

My would-be benefactor assured me, in hurt tones, that this was not the case. Telling me that I was an extremely lucky chap, he led me along to a beautiful, white, twin-engined aeroplane. A mechanic was filling the tanks.

Whilst I was waiting beneath a wing, a man came up to me :

"This is the machine in which you're to travel," he said. "You will be alone on board."

"Alone ?" I asked, taken aback, "but I don't know anything about flying."

"The only passenger," he replied drily.

I then found out that it was a Danish plane on the scheduled Copenhagen—Paris run. Owing to bad weather it had landed the evening before at Brussels and the passengers had been taken on to Paris by bus. But this afternoon it was leaving for Paris, to return from there to Copenhagen.

"You can get in," the man said, and he wished me a good journey, simultaneously apologising that none of the crew spoke or understood French.

I got in. Thirty-six empty arm chairs in a roomy, wonderfully illuminated cabin. I tried them all while the pilot revved up the motors and turned the aeroplane to face the wind. The air hostess, a charming brunette, then came out of her galley and fixed a belt round my waist.

"Ah, she wants to stop me from playing with the chairs," I thought.

But I was wrong, of course. It was a precaution taken for the take-off, but we became airborne without my noticing it. When we were aloft the hostess offered me chocolates while, with what seemed a symbolic gesture, she slackened my belt.

I should have liked to see the land below, but we were flying through clouds and I couldn't see a thing. I felt like some expensive fruit wrapped in cotton wool.

After about eighty minutes one of the pilots appeared and said we were over Orly. Everything was according to schedule. I looked through the porthole, but could still see nothing below. All the lights were on my left. They glittered in the twilight like myriads of stars. I gathered that we were turning preparatory to landing. I put my clothes straight.. Imagine it. I was the only passenger. Thirty-six arm chairs, an air hostess, two pilots and a navigator for me alone. Never was there a millionaire, never a sovereign, who had travelled so luxuriously. The one time I travelled by air I was certainly doing things in style.

Impressed by my superiority the aeroplane made a perfect landing. I got up like a nabob, a prince, an emperor, to leave the liner which my crew had already left. Still full of my dreams I almost expected to hear "Long Live the King" and "Welcome Your Majesty." But all that appeared was a familiar figure wearing a *képi*—the French customs officer.

"Any freight ?" he asked.

The chief pilot made signs to show that he didn't understand.

"Any freight ?' the customs officer repeated.

"*Ja*," answered the pilot—and pointed to me.

What a come-down ! What a blow to my pride ! After considering myself for the last hour and a half the most important person in the world, I was suddenly relegated to the rank of an item of luggage.

I certainly came down from the clouds that time.

Yves Grosrichard.

"David and Goliath" of the helicopter family: above the "Little Henry" ram-jet helicopter is the huge McDonnell twin-rotor "Whirlaway."

Big Prospects

"Little Henry"

McDonnell Aircraft Corporation of St. Louis, Mo., has taken just one year to secure a place on the helicopter map — in fact a place at both ends of the map. Towards the end of 1946 the firm was able to announce successful flight tests of the world's largest helicopter, the twelve-seater "Whirlaway" built for the U.S. Navy and powered by two 450-H.P. "Wasp Juniors" driving two 40-foot-diameter rotors, each engine being able to drive both rotors. At the end of 1947 came the news that the world's smallest man-carrying helicopter had successfully taken to the air. McDonnell's latest baby, which is the outcome of two years' research and close cooperation between the Air Force at Wright Field and McDonnell engineers, has the added distinction of being the *world's first successful ram-jet helicopter*. And in token of their affection, its parents have christened it "Little Henry," a name taken from a book called "Henry the Helicopter" by Eleanor Graham.

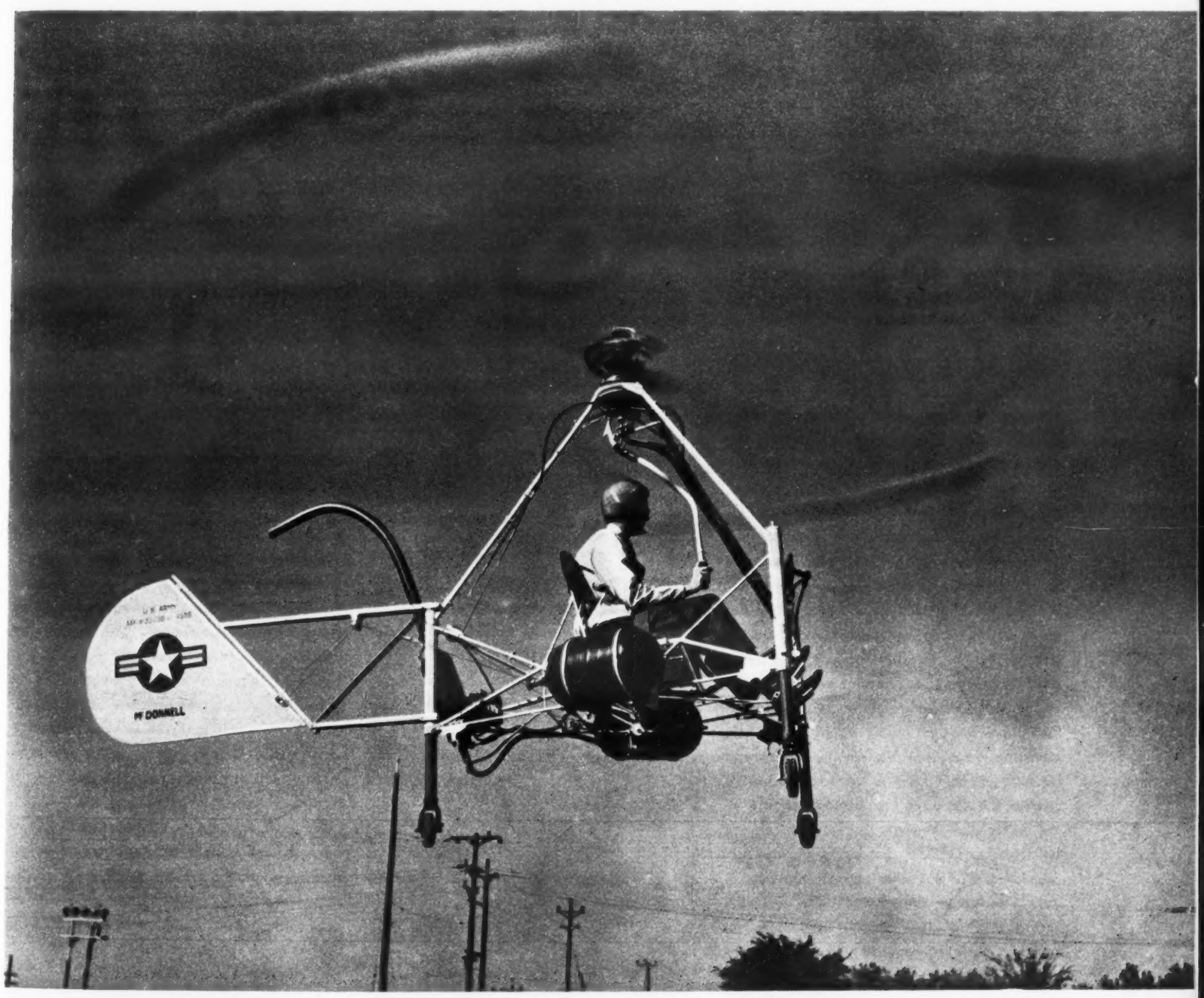
"Little Henry," in its—or rather his—age of adolescence, actually looks more like a flying test stand than an aircraft. But that is what the first ram-jet helicopter is really meant to be and, moreover, it is a test stand that really flies and has about nine months' testing behind it, for the first flight was in May, 1947. This experimental construction has fulfilled its purpose, namely to prove and demonstrate a novel basic idea. At the same time, it has stolen a march on a number of European designers who have been working on the same problem for years (Roy, Dobblhof, those of SNCA-SO, for instance).

Ram-Jets as Motive Power.

The basic principle of this new type helicopter is to drive the rotor by means of ram-jets at the blade-tips. In this way the thrust required to create the rotor-lift, or to overcome its resistance, is produced "on the spot," as it were. There is consequently no complicated system for transmitting power, no mechanically-driven rotating part and therefore no torque. The result of this simplification is a considerable reduction in weight, since transmission shafts, gears and the complicated control system usually featured by a helicopter are invariably heavy—and expensive—and constant "Bogies" for helicopter constructors. "Little Henry" has the amazingly light weight of 310 lbs. and, tough for his size, can lift an additional useful load of 300 lbs.

The ram-jets or athodyds (*A*ero-*T*herm*o*-*D*ynamic-*D*uct) powering "Little Henry" have no moving parts (e.g. compressors) but increase the pressure of the combustion air solely by converting velocity into pressure in a streamlined open-ended tube, or duct. The velocity of the air flow is governed by the tip speed of the rotor blade, which is at least 600 feet per second and correspondingly more at full power. More or less heat, that is to say, fuel, can be added to this air according to the amount of compression achieved. The addition of heat increases the velocity of the air and the fuel's combustion gases increase its mass. The thrust produced by the duct thus corresponds to the difference between the impulse variation per second of the combustion gases and that of the air sucked in. However, as these ram-jets do not produce any notable thrust at tip speeds under 600 feet per second, an auxiliary starter is needed for the rotor. On the other hand the ducts themselves do not need to be warmed up, which is an appreciable advantage if the climate is cold. The fuel—liquefied propane at present, though later it is intended to use ordinary gasoline—is vaporised in a pre-heater to build up enough pressure for starting. The necessary pressure or pumping action for keeping the system in operation is provided by the centrifugal force in the hollow rotor blades, along which the fuel passes and burns evenly in the ducts. The ram-jets are of special heat-resisting steel and weigh only ten

The "flying test stand" in flight : at the controls is C. R. Wood, Helicopter Chief Test Pilot and Manager of Helicopter Contracts at McDonnell Aircraft Corp. The rotor whirls at such a rate that only a faint outline of the ram-jet units can be seen.



Control is very simple : with his left hand the pilot twists the throttle to regulate the fuel flow and moves it up or down to alter the pitch of the rotor blades ; his right hand grasps the hanging steering bar, fastened directly to the rotor hub, with which he can tilt the plane of the rotor disc. The pre-heating chamber, with a long exhaust pipe, vaporises the fuel before it is fed to the ram-jet engines.

pounds each. They were developed by McDonnell engineers after three years of research and experimental work.

Simple Construction.

The two-blade rotor has a diameter of 18 feet (and therefore a rotor disc area of 255 square feet) and rotates, as can be discerned from the photo of the "aircraft" in flight, at a relatively high speed. The metal blades feature a thin, high-speed, laminar-flow aerofoil section : their pitch can only be altered collectively (and not cyclically as well). During flight the blade pitch will probably have to be small owing to the high tip speed. There are no flapping or rocking hinges. As there is no torque the rotor spindle is merely the means of attaching the rotor to the structure and there is no necessity for an auxiliary tail rotor or any other anti-torque device.

Accordingly, the control is very simple. The spindle bearing the rotor head need only be tilted in the direction necessary for equilibrium or for the movement desired by the pilot. It is done by means of a hanging steering bar, in the form of a double-armed lever with mobile fulcrum and with the upper arm attached directly to the spindle. The three springs visible in the photo are evidently for holding the spindle in a central position. The angles of blade-pitch always remain the same in the separate sectors of the rotor disc, though they can be altered collectively. This is done with the throttle, which can be twisted to regulate the flow of gas, or moved up and down to alter the pitch of the rotor blades. For forward flying, in which "Little Henry" has already reached speeds of 50 miles per hour in the tests, stability is achieved by a rudder actuated with a pedal.

The present pyramidal open-air structure carrying the pilot, fuel containers, pre-heating chamber, throttle and instrument panel, will presumably be given something in the way of a streamlined canopy when the tests are finished. When it goes into serial production, even if it were only intended to produce a "three-dimensional aerial motor cycle"—the category into which its weight brings it—a streamlined construction will no doubt be decided upon. The same applies to the under-carriage, which is at present very primitive.

The Prospects.

One thing is certain : "Little Henry" can fly. As to how he does so, the manufacturers do not give many details ; and many questions remain open.

General James H. Doolittle, famed Commander of the 8th U. S. Air Force in the Pacific and now Vice-President of Shell Union Oil Corp., tries his hand at the controls of the test model. On the right is J. S. McDonnell, President of the firm ; on the left are C. L. Zakhartchenko, Helicopter Chief Engineer, and C. R. Wood, Helicopter Chief Test Pilot.

First there is the problem of the ram-jets and the rotary speed of the rotor. We know that ram-jets only reach their best performance level at near to supersonic speed. But then the aerofoil section of the rotor blades will not be as efficient and when the sonic barrier (over 820 feet per second) is approached, dangerous blade vibrations could occur. Therefore the blade tip speed, or the ram-jet's speed through the air, will probably not exceed 800 feet per second, though it will exceed 600. This corresponds to a rotor speed of 850 to 640 r.p.m. Helicopters usually have tip speeds of 250 to 300 r.p.m. There is also no datum as to thrust, power and consumption. For the present, fuel consumption is no doubt disproportionately high. Systematic research will certainly lead nearer to perfection, particularly with regard to the duration in the air and the range. In order to make the little helicopter a really practical vehicle, the propane fuel is to be replaced by ordinary gasoline, obtainable everywhere. Another unanswered question is how the rotor is worked up to 640 r.p.m. Is this done by auxiliary rockets, or are rocket-devices perhaps somehow built into the power plant ?

The auto-rotative characteristics of the new helicopter are not yet satisfactory. If the ram-jet ceases to function, or if the fuel gives out, it should be able to land safely in an autogyro glide. Evidently the present ram-jet engines still cause a little too much drag. Experiments are therefore being pursued in this direction. Finally, a further problem is whether the rigid construction of the rotor without flapping or rocking hinges will prove its worth after long service. The longitudinal tensions in the blades, due to the centrifugal force caused by the high tip speeds, together with only moderate bending tensions as a result of the air forces, should have a favourable influence.

In spite of these open questions, the ram-jet drive signifies a new and promising trend in rotary wing aircraft design. The surprisingly simple construction of all the parts results in extreme simplicity of maintenance and, what is more important, no necessity for specially-trained pilots. It is therefore to be imagined that "Little Henry," or a more advanced version, will in a few years be able to be used in the Army and by private individuals as a cheap and easy means of transport. But it can also well be realised that the McDonnell works, after their success with this little aircraft which is destined primarily for Army liaison and observation work, will want to start on a larger type capable of lifting heavy and cumbersome loads over short distances to otherwise inaccessible places. *Ri.*

High-Altitude Flight and Air-Conditioned Cabins

Why Fly at High Altitudes?

In the early days of flying, in the 1920's, the airman was rightly considered the hero of a "battle with the elements." Almost every book on aviation of that period tells of flights in which aeroplanes had to fight their way through storms with only one feeble engine; in which they struggled with air currents in narrow valleys to gain height so as to surmount mountain ranges; in which they were racked by storms and strained to the limits of structural strength.

Already in the pre-war period there existed several types of powerful engine for transport aircraft, giving them speeds of nearly 200 miles an hour, so that they could defy contrary winds and had sufficient climbing power to fly over obstacles and storms. If air transport today deserves its name, then this is due in great measure to the efforts which have been made to increase *cruising speeds and flying altitudes.*

The second World War did not check this development. More than ever before, speed is spoken of as the most important performance datum of an airliner, and the new conception of the pressurised cabin shows the great value attributed to altitude airworthiness. Why is this, if the aeroplane possesses both these qualities to a sufficient extent to dominate its particular element? Have these two terms taken on a new meaning?

With regard to speed the answer is simple: just as with motor cars and railway trains, with the lathe and the typewriter, it means that time is gained by the aeroplane, too; and time is money. But what is the point of more altitude than is absolutely necessary, for all we want is just to travel from house to house, and houses are at present only built on the ground? The answer can only be taken from the inherent character of aeroplanes and from that of the element in which they pursue their activity—the atmosphere.

Concerning the *structure of the atmosphere* we know that lower barometric pressure prevails in the "high-up" regions and that the air is "thinner" and colder than at sea level. Instead of going into long discussions as to the why and wherefore of these changes, which in any case are dependent upon the weather as well, we refer readers to the graphs in figure 1. These show the average values for pressure, density and temperature of the air at altitudes from 0 to 80,000 feet. Let us take one example: at 35,000 feet altitude the air pressure averages scarcely 7 inches of mercury, as opposed to 29.92 inches at sea level; the temperature can be assumed to be —66 deg. F., while the density of the air is only 31 per cent. of that on the ground.

We will also deal briefly with the way in which this different condition of the atmosphere affects the *performance of the aeroplane* at various altitudes. We can say, broadly, that the decrease in air density at high altitudes must be compensated by greater airspeed in order that lift corresponding to the weight of the aeroplane may continue to be furnished. This increase in speed, also owing to the reduced air density, does not as a rule involve additional drag but nevertheless necessitates greater engine power. On the other hand, at high altitudes it is difficult to obtain even the same power from the engines as near the ground, since every combustion engine needs a certain air-weight per second to produce a certain power. Without artificial aid, however, it can only take in a limited volume of air, thus a weight of air which decreases as the density of the atmosphere diminishes. In principle, the power of piston engines can be maintained up to great altitudes with the aid of an exhaust-driven turbosupercharger; but as the lowering of the air density greatly impairs their cooling effect, the furnishing of extra cooling air, eventually by an additional blower, requires extra power; this means loss of power at those altitudes and, consequently, increased fuel consumption. In the case of airscrew-turbines and jet-propulsion engines the power also decreases with altitude, just as it does with non-supercharged piston engines, though it improves far more than with the latter when the speed is increased. To illustrate this, Fig. 2 shows the cruising power at which best engine economy is obtained—at about 60 per cent. of the

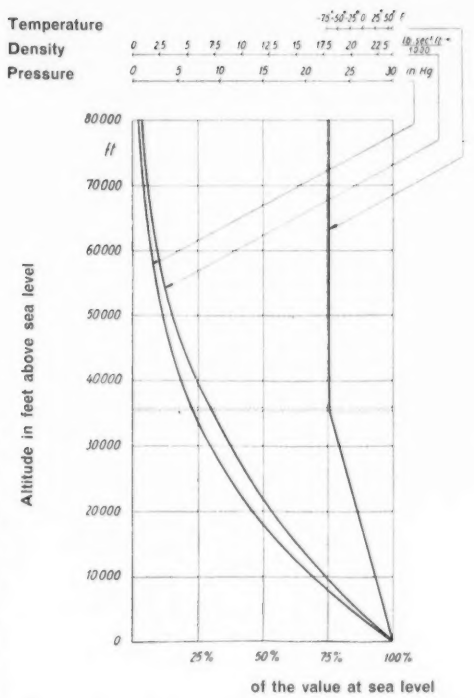


Fig. 1: Variation of pressure, density and temperature of the air with altitude.
NACA or ICAO (ICAN) normal atmosphere; the only difference is that the reduction of temperature according to NACA stops at 35,332 feet with —67 deg. F. (—55 deg. C.), according to ICAO (ICAN) at 36,089 feet with —69.7 deg. F. (—56.5 deg. C.)

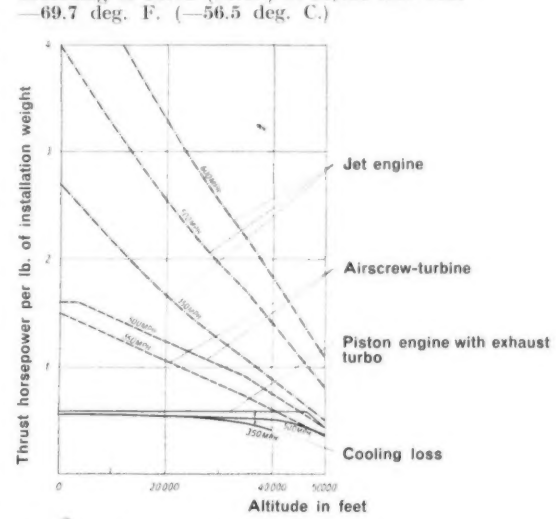


Fig. 2: Economic thrust output of various engines versus flying altitude and speed.

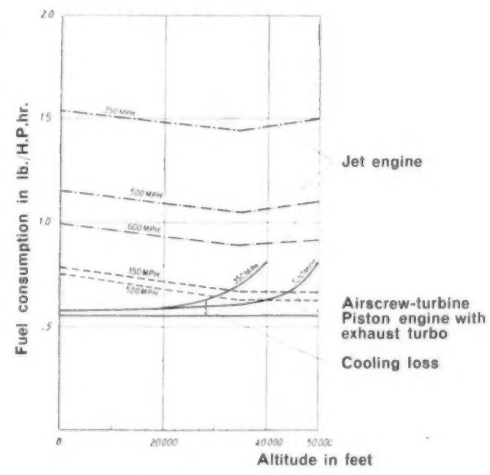


Fig. 3: Fuel consumption of various engines versus flying altitude and speed.

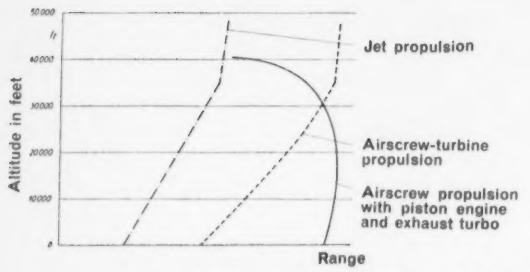


Fig. 4: Range variation with cruising altitude according to type of engine used.

maximum power for piston engines and at maximum continuous rating for airscrew-turbines and jet engines. Corresponding fuel consumption is shown in Fig. 3. It shows that the gas turbine works more economically at high altitudes than the piston engine.

Fig. 4 shows the effect of altitude upon range. It can be seen from this illustration that the range of aircraft with *piston engines and exhaust turbos* is not appreciably extended when high altitudes are sought. For such aeroplanes the advantage of altitude-flying is principally one of cruising speed, which may be 60 per cent. higher at 30,000 feet than at sea level. However, if the airscrews are driven by *gas turbines* the range, comparatively small at low altitude, increases considerably as altitude is gained, and above 30,000 feet even exceeds that of reciprocating engines; the cruising speed attainable at 40,000 feet may amount to 40 per cent. more than at just above the ground. Finally, it is clear that with *pure jet aircraft*, too, the range likewise increases with altitude, though not to the extent that is possible with airscrew-driven aeroplanes; speed at 40,000 feet is again 40 per cent. more than that when flying near the ground.

To a certain extent, this answers the question as to the *utility of high-altitude flying*. Flying at altitudes superior to those previously customary results first in added speed and also, to a lesser extent, in increased range. The fact that altitude-flying improves the potentialities of turbine- and jet-driven aircraft in particular, can only be considered an advantage once the favourable characteristics of these new kinds of power plant justify their utilisation in instances where the piston engine is still their superior in output and economy. And the prospect of such a development is reason enough to devote some attention to the demands imposed by high-altitude flight.

What are these demands? What points must be considered with regard to air transport at high altitudes and in the construction of high-altitude commercial aircraft? The answers are provided in a series of lectures presented at the Boeing High-Altitude Flying Symposium at the Boeing Aircraft Company, Seattle, in August, 1947. At this meeting, reports were given of the results of intensive research work which Boeing engineers carried out in collaboration with the U.S. Air Force, subsequent to the development of their B-29 "Superfortress" long-range bomber. During 53 flights the research group spent more than 82 hours at an altitude of over 40,000 feet, while the number of flying hours above the 25,000-foot level exceeded 1,300. Of the three Boeing B-17 "Flying Fortresses" and the two B-29's at the disposal of the research workers, the company's laboratory aeroplane, a B-29 christened "Noah's Arc," performed the greatest part of the work by making 32 ascents up to 40,000 feet.

The Dangers of the Air Desert

The man who enters the higher strata of the atmosphere is threatened by no fewer dangers than a traveller in the desert. Just as lack of water may be fatal to the desert traveller, *lack of oxygen*, that element vital to breathing, can bring about the death of an air traveller. Already at 10,000 feet altitude, as Fig. 1 shows, the density of the air only amounts to about 74 per cent. of its density at sea level, so that the passengers in an open aeroplane only get three quarters of the usual amount of air and oxygen at each breath. Fatigue and lassitude occur here already, leading at higher altitudes to a progressive loss of capacity for judgment and action, and ultimately to unconsciousness. Even at 5,000 feet, slight but none the less important signs of anoxia are ascertainable; proficiencies of night vision and accommodation to darkness are weakened, the peripheral vision becomes dimmed, and 23 per cent. stronger illumination is needed to discern an object at 5,000 feet as clearly as at sea level. (At 10,000 feet it must be 59 per cent. stronger and, at 16,000 feet, as much as 140 per cent. stronger.) It is therefore a general rule in the U.S. Air Force that fliers begin artificial oxygen respiration at 10,000 feet in the daytime and at night either already on the ground or at any rate at 5,000 feet.

If lack of oxygen is a consequence of lower air density, *diminished air pressure* also has its unfavourable effects. Known under the word 'aeroembolism,' these lead to expansion of the internal body gases, to elimination of the nitrogen dissolved in the blood, and

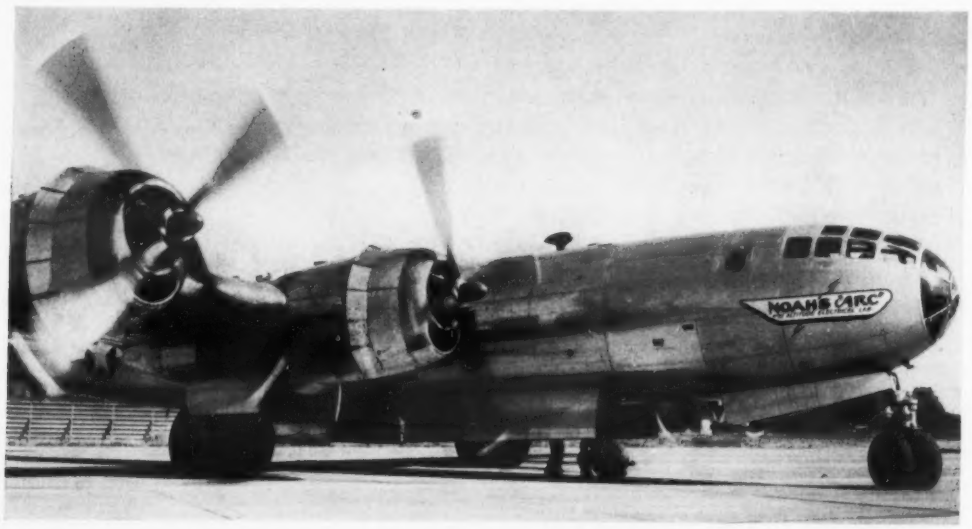


Fig. 5: Boeing's high-altitude laboratory aircraft, the "Noah's Arc," a converted Boeing B-29 "Superfortress" long-range bomber, had already carried out 32 altitude flights at over 40,000 feet by the end of July, 1947.

Fig. 6: Two members of the high-altitude flight crew: Pilot James A. Fraser (left), who, up to the end of July, 1947, had carried out a total of 43 experimental flights with Boeing B-17's and B-29's at 40,000 feet, and Flight Engineer Ben Warner (right), who has made no fewer than 46 experimental flights at this altitude.

are manifested in the form of flatulence, and pains in the joints and muscles. Aeroembolism rarely occurs below 25,000 feet : however, after one hour's exposure at 35,000 feet, experience has shown that approximately one in ten pilots will probably be incapacitated by aeroembolism, while after only 20 minutes' exposure at 40,000 feet, this probability increases to nine out of ten. The extreme pressure limit for human beings is at 63,000 feet altitude, when the blood begins to boil at body temperature.

A significant hazard, of a similar nature, for normal airliners with pressurised cabins to protect passengers against ill effects of high-altitude flight, is that the interior of the cabin may suddenly come into contact with the outer air—owing to a broken window, for instance. Thorough research has shown that such an occurrence is not of vital danger under fairly normal circumstances. In a medium-sized airliner, the air could suddenly escape through an orifice eight feet in diameter (a large doorway) at 40,000 feet without the drop in pressure having fatal results. Of course, measures must at once be taken against the resultant shortage of oxygen.

Meanwhile, quite small changes of pressure can also be exceedingly painful to a passenger with an occluded sinus, who cannot adjust the pressure in the middle ear to the external pressure by swallowing, etc. A slow change in pressure, however, such as takes place during ascent and descent at 600 feet in a minute (double the usual rate occurring in commercial flying), will subject a healthy person to aural sensations so small that he is not even disturbed in his sleep.

The unpleasant features and dangers of the *low temperature* prevailing at high altitude can easily be imagined and need not be mentioned further here. Less conspicuous, meanwhile, is the fact that these are coupled with *unusually low humidity* of the air. For example, one pound of saturated air at 70 deg.F. contains 0.0157 pounds of water, while at —60 deg.F., the temperature prevailing at about 33,000 feet altitude, it contains only 0.000021 pounds. The air desert !

From Oxygen Apparatus to Pressurised Cabin

In everyday life we have several ways of protecting ourselves from the rain, which vary according to our purse and our occupation. One man, when he leaves his home, takes his umbrella, raincoat and galoshes, while another goes by tram or calls a taxi. There are also various protections against the inclemency of exposure at high altitude : we have already mentioned the oxygen apparatus and the pressurised cabin. The former, like the umbrella, is handy ; it presents no complicated equipment but, like an umbrella, is only of limited efficiency. Let us pause a while to consider this useful device, so that later we can appreciate all the more the advantages of the pressurised cabin.

As we have already said, in daytime an aviator begins breathing oxygen at an altitude of 10,000 feet, and at night already at 5,000 feet. At these altitudes pure oxygen is not yet breathed, for the modern equipment provides a mixture of air and supplementary oxygen, together containing just the necessary quantity of oxygen. As altitudes increase a regulator raises the supply of oxygen until at 40,000 feet the apparatus is only giving pure oxygen. It is at about this altitude that the quantity of oxygen contained in a cubic foot of air at low altitudes alone takes up the entire volume necessitated by this cubic foot as a result of the diminished pressure. At a still greater altitude, therefore, a normal oxygen apparatus can no longer satisfy the body's requirements. A certain degree of improvement can be obtained if oxygen is forced under pressure into the lungs by means of a closely-fitting nose and mouth mask. The airman must then train himself to breathe out with a certain expenditure of energy—an exercise which, as a matter of fact, would be quite good for the health of sedentary, earth-bound people. However, this expenditure of energy limits the top level for the use of pressure breathing to about 6½ inches of water positive pressure if this breathing process is intended as a normal measure, and to about 12 inches of water positive pressure if it only has to serve under emergency conditions. The critical altitude of 40,000 feet rises to 42,000 feet—or, for short periods of use, to 50,000 feet—if such breathing appliances are employed. For greater altitudes adequate breathing and oxygen supply can only be assured by inflatable pressure suits or by pressurised cabins, which envelop the pilot's entire body.

But free breathing is not everything. *Pressurised cabins or pressure suits* are also necessary above 40,000 feet because of the direct effect of the decreased pressure, and because of the flatulence, joint and muscle pains already mentioned. For the professional airman there are certainly ways of dealing with them, but which one can hardly expect the passenger to use. The personnel of the Boeing altitude research group were instructed to do physical jerks for at least half an hour before every flight likely to take them above 25,000 feet. This worked the harmful nitrogen out of their systems. For another hour before the start they had to breathe only oxygen instead of the air, which is full of nitrogen. This procedure contributes much to reducing these complaints. On the other hand every physical effort made during flight accelerates their appearance.

Are there measures to increase the resistance of passengers to a possible failure of the pressurised cabin and the subsequent effects of explosive decompression ? Research carried out by the U.S. Air Force just before the meeting we have mentioned at any rate revealed that if altitude trouble is combatted by breathing oxygen, subjects remain fully conscious 40 per cent. longer after mask failure or removal than if they are getting air under normal pressure in the pressurised cabin and the latter is rapidly decompressed.

Military aeroplanes which fly above 25,000 feet have a kind of pressurised cabin as part of their standard equipment. This pressurised cabin, however, can serve fundamentally different purposes :

1) It can serve to render oxygen breathing entirely unnecessary by maintaining in the cabin, for all altitudes, the air pressure normally prevailing at 8,000 to 10,000 feet. The four-engined Boeing B-29 " Superfortress " long-range bomber, for example, has a pressurised cabin of this kind.

2) At great altitude the pressure in the cabin is kept only as high as it would normally be at 30,000 feet. The crew is then sufficiently protected from the effects of exposure at high-altitude (bends, chokes, etc.) but for breathing they have to use oxygen equipment. An example is the Lockheed P-80 " Shooting Star " jet fighter.

3) Cabin pressurisation is only used to maintain a cabin altitude below the oxygen ceiling of 40,000 feet. This means it is sufficient for the breathing of pure oxygen. The Bell XS-1 supersonic research plane has one of these cabins. In special instances of this kind, full use can be made of the resistance of particular pilots to pressure effects.

" Splendid Isolation " for the Passenger

Only the first of these three kinds of pressurised cabin is suitable for civil aviation, as the others involve the use of an oxygen mask by the passenger. The maintenance of cabin pressure, deliberately chosen and independent of flying altitude, solves beforehand the vital problems of breathing and counteracting the unpleasant effects of pressure changes.

How high should the cabin pressure be ? The medical expert and the aircraft designer give different answers according to their own points of view, and the authorities and airline companies who buy the equipment and arrange for its installation decide and level out the differences. Dr. W. R. Lovelace of Albuquerque, New Mexico, Member of the Scientific Advisory Board of the U.S. Air Force, Medical Director of the T.W.A. System and Surgical Consultant to Northwest Airlines, would like to have this pressure correspond to an altitude of 5,000 feet. In his own words, " Comfort may be defined as the state in which one is unconscious of

adaptation to one's environment. Discomfort, on the other hand, implies consciousness of the accommodative processes that are being made by the body. Discomfort can also extend to a level of pain ... When a human being whose normal environment is sea level is flown to 8,000 feet, he must accommodate to this level by changes in respiration. He is conscious of an accommodative effort. (This is a common experience of air passengers from the East and West Coasts when they get off for a stretch at Albuquerque, 5,100 feet.) Although he is not necessarily cyanotic (suffering from oxygen shortage), he has a sensation of air starvation when exercising. Passengers do not have a sense of comfort or complete freedom from this sensation above 5,000 feet until they are acclimatised. Normal, healthy people can accommodate to altitudes as high as 12,000 feet. On the other hand, cyanosis has been observed at altitudes as low as 8,000 feet in normal subjects acclimatised to sea level. "

The minimum pressure stipulated is less interesting to the engineer than the raising of the cabin pressure above the prevailing outer pressure, for this pressure differential determines the increased weight of the cabin wall and the output of the air compressors. His manner of replying is to produce a finished aeroplane featuring a cabin differential pressure at high altitudes. In the pre-war Boeing 307 " Stratoliner " this differential amounted to 5.28 inches of mercury, enough to maintain at ceiling altitude, 20,000 feet, the cabin pressure ordinarily prevailing at 12,000 feet. Nowadays, in the " Superfortress " and in the " Stratocruiser, " pressure differentials amounting to 13.34 inches of mercury can be maintained. In this way, sea level pressure can be maintained up to 15.500 feet, that prevailing at 8,000 feet up to 30,000 feet, and that found at 12,000 feet up to about 4,000 feet.

The problem of protecting passengers from the ill effects of high-altitude flight has therefore been solved : sufficient pressure, enough air for breathing, and heating will also be provided. Comfort ! You would then feel as well as you do in a railway train or in a motor car and, it may be whispered among friends of aviation, that is not so good in winter. Your feet get cold, even when the compartment is overheated, apart from the fact that it is dry, noisy, draughty, smelly and smoky. It ought to be better in an aeroplane ; and in a high-altitude airliner it must be and can be better. The cabin is isolated from the outside world and its atmosphere is artificially prepared. If it is prepared " tastefully, " the pressurised cabin can become an *air-conditioned cabin* and its " isolation " may be splendid.

Comfort is not just a vague term to the air-conditioning engineer, but one which can be reduced to figures. Experts have known for a long time that the feeling of comfort is not merely a question of room temperature, but concerns the amount of heat and moisture which the human body gives out. This heat and moisture given out not only depend on the *air temperature* but also on the *humidity of the air*, its movement *(draughts)* and the *temperature* of the walls which, by radiation, affects those within them. A truer index of passenger comfort than the dry bulb temperature is the so-called effective temperature. This is the temperature of still air 100 per cent. saturated with moisture, which shows the same sensitivity to heat as the air condition under consideration[1]. As Mr. R. L. Linforth (Group Engineer, Air Conditioning, Boeing Aircraft Company) stated at the symposium at Seattle, the ideal figure is an effective temperature of 68.5 deg. F., which at 30 per cent. air humidity corresponds to a dry bulb temperature of 75 deg., at 50 per cent. humidity to 73 deg., and at 70 per cent. humidity to 71 deg. If the ventilation of the Boeing " Stratocruiser " supplies 80 pounds of fresh air per minute, which in the " air desert " is practically free of water, and if for the desired average degree of humidity of 50 per cent. 0.008 pounds of water must be added to every pound of air, this comes to about 38.5 pounds of water per hour. It must be carried in containers, with the result that every five hours of comfort for the ninety passengers costs the airline company as much in water alone as the transport of one paying passenger. Thorough investigation has shown, however, that air humidity can be reduced to 20 per cent. without ill effect if an effective temperature of 65 to 68 deg. F. is maintained by increasing the dry bulb temperatures accordingly.

Decreasing the air humidity helps to overcome a further difficulty. When the aeroplane encounters outside temperatures down to —65 deg., the walls and windows of the cabin become very cold too. Contact with them cools the air and when they go below their dew point, the humidity is precipitated on the walls and windows as water or ice. If it is 50 per cent. saturated at room temperature (70 deg.), the dew point is reached at 50 deg., but if it is only 20 per cent. saturated, the dew point is at 28 deg. Reducing the humidity content thus decreases the disadvantage of water condensation on the walls very considerably. Another way of avoiding this disadvantage is to insulate the walls and to heat the windows. It is also indispensable for the comfort of air travellers the the temperature of the cabin walls should not be greatly different from that of the air in the cabin. Effective temperature as a true index of passenger comfort only applies on this condition.

In warm regions and seasons, when the aeroplane is on the ground or flying at low altitude, the air in the cabin must often be cooled and at the same time dried. For both these purposes, therefore, a refrigeration system with a water eliminator has to be provided, as well as heating and evaporating equipment.

As a matter of course, *ventilation* goes hand in hand with the general conditioning of the air with regard to pressure, temperature and moisture. The carbon dioxide exhaled by passengers, the odours, vapours and tobacco smoke, must all be removed. Aeroplanes with sealed-off, air-conditioned cabins have both advantages and disadvantages compared with aircraft without artificial ventilation. On the one hand, the used-up air is almost entirely absorbed and returned for use again by a central purifier ; on the other hand, it cannot be drawn off freely and in sufficient quantity into the open air. A good ventilation system must above all supply a definite quantity of odourless air for every passenger. Part of this quantity can be obtained by purifying the air drawn out of the cabin. But another part must come from outside the aircraft, so that the contents of exhaled carbon dioxide in the cabin do not exceed a prescribed maximum. Fig. 7 shows the relation of the quantity of fresh and purified air needed for each passenger, to the size of the cabin.

When wounded are conveyed in troop transport aeroplanes, it often happens that only a small cabin volume can be allocated each patient, although this is a typical case where strong odours often occur. As it is practically impossible to master the situation by simply increasing the air circulation, activated charcoal is placed under the stretcher coverings, thus isolating the odour source ; the method has proved quite satisfactory. It is also worth mentioning that the air-purifying filters also catch a large percentage of the bacteria in the air and that the ventilation system can be used, without further adaptation, for pulverising and distributing disinfectants and insecticides throughout the whole cabin.

The introduction of *sound-proof wall-linings* has already reduced the discomfort caused to passengers by engine noise to such an extent that there is no reason to dwell on this feature. Airtight closure of the cabin and its careful heat-insulation are two mandatory conditions which can but further the progress of altitude flying.

There are differences of opinion about *safety measures in case of pressurisation failure*, just as there are about the interior pressure of cabins. Dr. Lovelace energetically supports the view that no difference at all should be made between civil aircraft with and without

[1] Cf. Article by M. Hottinger: "Behaglichkeits-Masstäbe," Schweizerische Bauzeitung, Vol. 65, Nos 8 and 9 (22nd February and 1st March, 1947), P. 98-102 and 107-112.

pressurised cabins: aeroplanes with pressurised cabins must have oxygen equipment which can and must be used by the crew if the pressurisation is defective, on night flights above 5,000 feet and on other flights after 30 minutes above 10,000 feet, while above 12,000 feet it must be used all the time by both passengers and crew members. If only low altitudes are flown, oxygen should still be provided for the crew and 10 per cent. of the passengers. Regulations for American military aircraft are still stricter—oxygen for all air crews above 10,000 feet and on flights of more than four hours above 8,000 feet. According to the ICAO regulations too, even aeroplanes with pressurised cabins must carry the necessary breathing equipment and an emergency oxygen supply for the crew if it is planned to fly at 10,000 feet or more. Dr. Lovelace warns airline companies against asking for further alleviations, for instance a raising of the " oxygen " limit to 14,000 feet. Elderly and sick persons count among the passengers nowadays, and every month in the U.S.A. at least 10,000 patients travel by air to hospitals and clinics. If the pressurised cabin fails, the weather and the terrain which is being crossed often do not permit the pilot to fly as low as he likes. Oxygen masks can be put on at leisure if the altitude is under 18,000 feet. If a greater altitude is to be flown, this should be practised at the be ginning of the flight under the supervision ofthe stewardess, just as lifebelt drill is practised at sea, for if pressure is lost above 25,000 feet, unconsciousness occurs after four minutes.

Experience has shown, however, that even if oxygen masks are at hand, the passengers will not use them before 15,000 feet altitude, and will put up with a certain amount of tiredness in consequence. For this reason, elaborate regulations about oxygen provision are not issued. Airliners must certainly be improved so much that defects of pressurisation are as rare as wing breakages. Then special emergency measures in this sphere could be dispensed with as easily as parachutes.

To sum up, the air-conditioned cabin, sealed off from the outside world in almost every respect, enables the passenger to exist in a little world of his own, in which almost all his wishes can be fulfilled—as long as considerations of weight permit. If we count among his wishes those of which he is not conscious, one question remains open: will science ever succeed in defining all the conditions that must necessarily be fulfilled if a person is to feel absolutely well? Do not new requirements continually appear, the list of which can never be completed? One example, the connection of which with altitude problems was not mentioned, so far as we know, at the Boeing symposium: What influence on humans has the ionisation of the air's oxygen, which is probably greater at high altitude owing to cosmic-ray action?

Fig. 8 and 9: Interchangeable filters of the air-conditioning system in the Boeing " Stratocruiser's " lower deck. On the right is one of the seven fibre-glass filters for ridding cabin air of dust and smoke; picture on the left shows the activated-charcoal filters for removing odours.

Air-Conditioning the " Stratocruiser "

The giant four-engined *Boeing Model 377 " Stratocruiser "* can operate at a ceiling altitude of over 30,000 feet and may therefore be exposed to ambient air temperatures varying according to locality and weather from —65 deg. to 100 deg. Its air-conditioning system has to serve the following purposes: " the control of the temperature, humidity, motion, purity, absolute pressure and rate of change of pressure of the air within the cabin." It also has to satisfy the physiological requirements already dealt with. How is this task accomplished?

To remove odours and smoke, the ventilating air flow was fixed at 40 cubic feet per minute for each of the 90 passengers and crew. Of these 40 cubic feet, 10 cubic feet is fresh air and the remaining 30 cubic feet is purified re-circulated air.

In flight the *fresh air flow*, provided at the rate of 80 pounds a minute, is bled, together with the engine combustion air, from the four turbosupercharging systems, compressed, and ducted by the engine intercoolers. The ducts then branch off, the air for the cabin being led from the nacelles to the air filter and combustion heaters in the forward cargo hold of the lower deck. If the engines are idle, this air flow is provided by means of two electrically-driven blowers, one located in each of the two inboard wing sections between the fuselage and the inboard nacelles. Together, these blowers are also capable of supplying 80 pounds of fresh air a minute.

In the forward cargo compartment, the fresh air first goes through a filter and is then led through two *combustion heaters* of 200,000 BTU/hr. each., regulated so as to bring the air to the temperature necessary for heating the cabin. The heated air is then conducted to the *air recovery unit*, in which it is first mixed with the unpurified air returning from the cabin. Another electric blower then forces the mixture of fresh and impure air through *fibre-glass filters* in which dust, dirt and a sufficient quantity of the visible ingredients of tobacco smoke and bacteria remain. When the air leaves this purely mechanical filter it is passed through a layer of activated charcoal, the fine pores of which remove odours (Figs. 8 and 9).

The air recovery unit also contains the evaporators of *two refrigerators*, of which the compressors and condensers are located in the outboard nacelles. Electric motors drive the compressors, while ordinary freon fluid is used for refrigeration. The cooling system can remove up to 120,000 BTU's per hour from the air, sufficient to provide a cabin temperature of 85 deg. with a full passenger load at an outside air temperature of 100 deg. Water which condenses during the cooling process is exhausted over board.

Provision has been made in the air recovery unit to *add moisture* as required to satisfy the selected humidity during cabin heating. Furthermore, a suitable insecticide could be introduced into the same part of the system, to flow through the entire pressurised section of the air-liner—an operation that is sometimes desirable when returning from overseas.

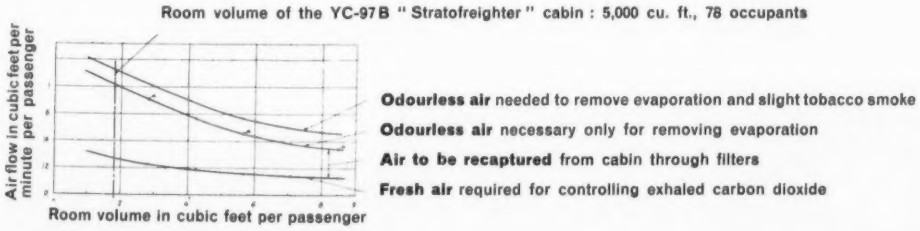

Room volume of the YC-97B " Stratofreighter " cabin : 5,000 cu. ft., 78 occupants
Air flow in cubic feet per minute per passenger
Room volume in cubic feet per passenger
Odourless air needed to remove evaporation and slight tobacco smoke
Odourless air necessary only for removing evaporation
Air to be recaptured from cabin through filters
Fresh air required for controlling exhaled carbon dioxide

Fig. 7: What quantity of air must be ventilated into an air-conditioned cabin so that the air in it remains breathable and odourless?

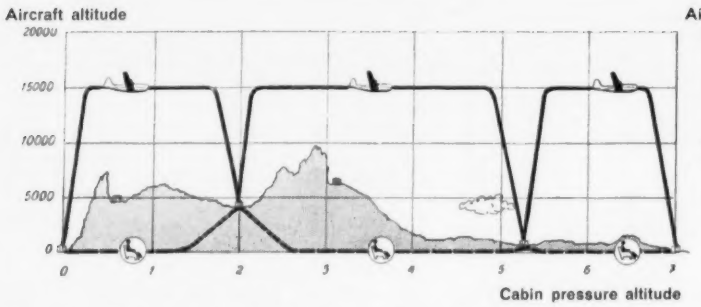


Fig. 11: Altitude flight plan for an aeroplane with air-conditioned cabin on trans-continental services with long route sections.

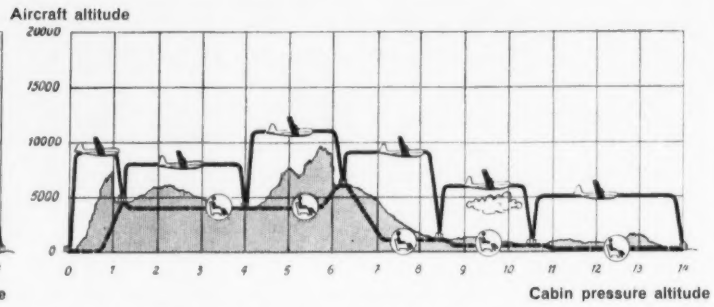


Fig. 12: Altitude flight plan for a flight with medium route sections.

Aircraft rate of climb, 1,500 ft./min.; aircraft rate of descent, 1,000 ft./min.; rate of cabin-pressure change, 100 ft./min.

Altitude in feet — — — Flight time in hours

The mixture of fresh and purified air flows from the recovery unit through a system of ducts which extends the whole length of the aircraft just below the main cabin floor. Branch ducts pass it between the cabin inner lining and the sound-proofing blanket, between each of the circumferentials throughout the entire length of the cabin. Passing upward in this space it enters the cabin through the ceiling fabric. The cabin windows have dual panes and the warmed or cooled air is passed between them. In this way the cabin inner lining is raised to a pleasant temperature which counteracts the radiation of body heat by passengers and increases comfort. In addition, the windows remain free from fog.

After passing through the ceiling fabric into the cabin, the air sinks to the ground according to the extent to which it has been cooled. Grilles at the intersection of the cabin wall and floor take it up and pass it into return ducts formed by the ceiling of the cargo compartment and the control cable guards.

The compartments in the lower deck are heated in the same way as the main cabin of the upper deck, and to a certain extent they are ventilated in the same way. The two *cargo holds* fore of the wing and at the rear also have wall heating, but their only ventilation is by leakage from the return ducts, spent air being exhausted overboard through venturies and the smoke detector of the fire alarm installation.

Fig. 10: Cockpit of the Boeing YC-97 "Stratofreighter," military version of the "Stratocruiser." The seven front window panes marked with × are electrically heated, the others obtain warm air direct from the heaters through special ducts.

The *lounge* in front of the rear cabin, containing a bar, has a horseshoe-shaped seat under which the return air ducts run. The supply ducts run through them in order to keep the air temperature somewhat lower than in the main cabin; passengers can provide additional heating for themselves by consuming liquids of high alcohol or vitamin content. For the rest, the bar has wall heating, ventilation through the ceiling and return air grilles at the foot of the seat.

In the *galley and lavatories* more air is exhausted overboard than is supplied by the distribution system. The amount lacking is passed in from the main cabin, thus preventing undesirable odours from spreading in the opposite direction. As the galley is also heated by the cookers and the staff are constantly at work, they can regulate the supply of warm air themselves.

Finally the *flight deck*. It obtains mixed air from the main distribution system through four grilles located at the floor line, each equipped with its own damper. On the other hand, heated fresh air for the cockpit does not come from the recovery unit, but directly from the combustion heaters through pipes. Their openings are close to the 19 window panes, which have no special frost protection device and are only of single-pane glass. The seven front panes, immediately in front of the two pilots' seats, are electrically de-iced[2] (Fig. 10).

Automatic *temperature controls* are provided in the main cabin, the cockpit, the lounge and the cargo holds. The main cabin section establishes the fresh and re-circulated air supply temperature. The controls in the other compartments correct the prevailing temperatures by changing the quantity ratio between the heated fresh air and the colder, purified return air. In the reverse case, too, when the fresh air is artificially cooled, the control in the main cabin maintains the temperature selected manually by the air hostess.

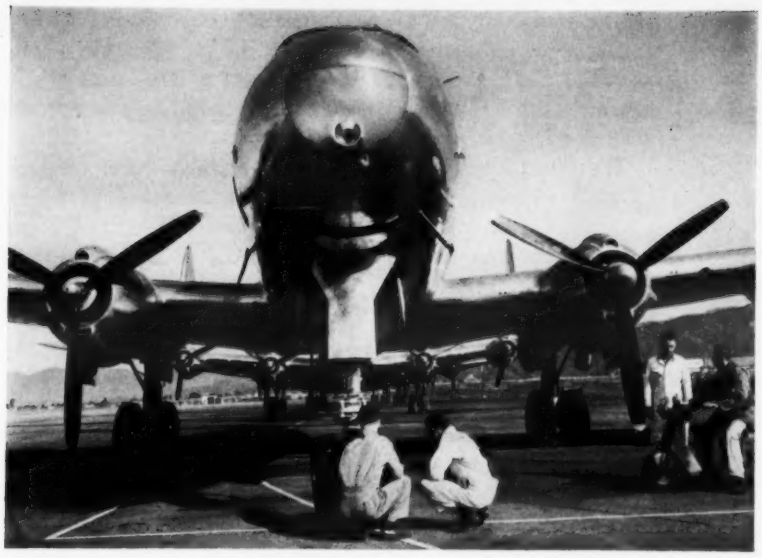
Pressure regulation is likewise automatic. The regulators are located in the lower section of the aircraft near the front spar. The desired pressure altitude can be selected as well as the rate at which the pressure is to be changed. The desired pressure can be maintained so accurately up to the maximum prescribed pressure differential of 13.35 inches of mercury, that deviation corresponds to a change of altitude not exceeding ± 100 feet. Expressed as apparent speed of ascent or descent, the rate of cabin pressure change can be fixed between 50 and 1,000 feet per minute, with a tolerance of 50 feet per minute either way. Indicators and a means of selecting these operations are located in the cockpit. Hence, a cabin flight plan commensurate with the real flight plan can be obtained, thereby providing the optimum comfort for passengers. (Figs. 11 and 12.)

If we return from this description, from the discussion of theory, research results, and plans for high-altitude commercial flying, to the point from which we started, can we say that concrete experience on its advantages has been gained? Trans World Airline could best answer this question, as their Lockheed "Constellations," thanks to pressurised cabins, are being flown at greater altitudes than usual on trans-continental and inter-continental routes. This company not only appreciates the directly discernible advantages of such airliners, but in particular their effect on operations as a whole. Flight planning is considerably simplified, flying hours become shorter and schedules can be better kept; flying is smoother and flexibility is increased; at high altitudes there is no overcrowding, and quick changes of altitude are no longer a problem. Many passengers would rather fly 2,500 miles across the entire U.S.A. in a pressurised airliner than fly a few hundred miles in an ordinary aircraft.

We know that it is this last opinion which has already inspired the airline companies to purchase aeroplanes with pressurised cabins, even for short distances and moderate altitudes. Is this only a fashion? Hardly—but this question deviates from the subject of high-altitude flight.

T.

[2] Cf. "Interavia, Review of World Aviation" Vol. III, No. 1, P. 35.



Research on Landing Gears, Wheels and Tyres

When we discuss aeroplanes we usually confine ourselves to their measurements and weights, their engine output and external form, not omitting, of course, their characteristics and performance data. Even among professionals the strictly flying features are so much in the foreground that the fact is often overlooked that, in two critical stages, namely when it takes off and when it lands, every landplane is just as much—or even more—a vehicle than an aeroplane. It is true that in the days when all-up weights and landing speeds were low it was unnecessary to make special demands of a landing gear. Many a private aviator who accidentally lost a wheel while taking off has been able, by luck or good judgment, to land smoothly on the single remaining wheel. But since large airliners have come to reach all-up weights around 135 tons, requiring landing speeds of about 90 m.p.h., any damage to the landing gear is likely to have disastrous consequences. The landing gears of large modern transports, especially the tyres, are endangered both by the great braking heat and the enormous friction between the (stationary) wheel and runway surface at the moment of setting down ; and, understandably, too much wear and tear may very well lead to a blowout.

In order to eliminate the fatal results of a landing gear being put out of action, at any rate as far as transport aeroplanes are concerned, an endeavour is made nowadays to provide, whenever possible, several landing wheels, placed next to or one behind the other. The outer covers of all aeroplane tyres are regularly subjected to a thorough inspection and changed fairly often. The life of a tyre—about 50 take-offs in the case of the Douglas DC-4—depends on the quality of the material, the roughness of the runway surface, the landing weight, braking power, etc., as well as on a safety factor determined on the basis of reliability and expense. It is interesting to recall in this connection the development work carried out on unburstable tyres some years ago in Germany. Instead of the usual inner tube for putting the tyres under internal pressure, sponge rubber was used, the interstices of which were filled with compressed gas. The sponge rubber ring and its gas filling was made in a steel mould from a mixture of rubber with certain chemicals, taken out in frozen state, thus inert, and fitted into the tyre.

Drop tests to simulate landing conditions.

The special importance attaching nowadays to safe landing gears had urged Lockheed Aircraft Corporation, of Burbank, California, to conduct elaborate experiments for investigating the processes, forces, and wear and tear occurring when the landing gear is set down on the runway. Up to now aircraft manufacturers have been used to leaving such experiments to firms specialising in the manufacture of landing gears and tyres, who determined, under very much simplified conditions, primarily the load deflection curves relative to the struts and tyres, i.e., their absorption of energy and the accompanying shocks. Lockheed's, however, wished to obtain exact data on the effects of all the subsidiary influences of landing

Starboard half of the 278,000-lb. Convair B-36 bomber's landing gear. The four-wheel arrangement not only increases safety, but also improves load distribution on the runway.

Testing a flat tyre at 80 m.p.h. (nose-wheel of a " Constellation ").

impacts—the acceleration of the landing wheels by the runway friction from dead stop to the revolution rate corresponding to the landing speed, influence of lift furnished by the wing, etc. Accordingly, they have virtually duplicated actual landing conditions very accurately on a test stand, with an elaborate array of automatic measuring instruments recording the impact.

The illustrations show how the experiments were conducted. A complete landing gear (belonging to a Lockheed " Constellation ") is mounted between two massive forty-foot-high steel towers set in a ten-foot-thick concrete block, and loaded with about twenty tons of lead to correspond to half the all-up weight of the airliner. The final speed of the landing gear at the drop corresponds to the downward vertical speed of the aeroplane. The gear, complete with its load of lead, is raised to the necessary height by cables operated by a gasoline engine. The lift furnished by the wing as well as the air-cushion effect at landing is duplicated by two vertical, calibrated metal straps which absorb an adjustable part of the shock. Before the drop, the wheels are spun in reverse to 600 r.p.m. by Dever electric motors in the hubs,[1] this revolution rate of the wheel (diameter 56 inches) corresponding to a landing speed of 100 m.p.h., thus about 20 per cent. higher than the normal landing speed of a " Constellation. "

The gear drops on a " floating " concrete platform, to simulate the material of a runway, and eight electric strain gauges record all vertical and horizontal loads on a graph in a series of wavy lines similar to those drawn on a seismograph by an earthquake. The considerable kinetic energy stored in the landing wheels, which is evidenced most of all by the revolution speed and the moments of inertia of the wheels, is absorbed in less than 1/10th of a second by the friction of the rubber tyre on the concrete stand, causing the skid marks on the tyre cover and on the concrete stand, visible in the picture, as well as a cloud of smoke during a few seconds after the impact. The magnitude of the friction involved is revealed by the fact that the wheel does not even make a full revolution before coming to a standstill. The horizontal forces produced—which, like the force of impact, must be absorbed by the strut and the structure connected with it—are also recorded with great precision by the electric strain gauges. For future study, each experiment was photographed by a high-speed motion-picture camera.

Although in the experiment some of the real landing conditions have to be reversed, they are extremely well duplicated for the test purposes. The new information gained is expected to result in the construction of lighter, stronger and more durable landing gears for all types of aircraft. Of course in doubtful cases, of estimated weight, for instance, construction must be on the safe side. Service experience has so far only led to increases in the weight of landing gears and never to a reduction. This circumstance might very well change, which would be most important from the economic point of view, too. The landing gears of large airliners usually comprise 10 to 14 per cent. of the empty weight. It may be recalled that each half of the Convair XC-99's landing gear weighs 8,550 lbs. and a single wheel with tyre, approximately 4,000 lbs.[2] Every decrease in weight of the landing gear must necessarily mean an increase in payload.

LANDING WHEEL PRE-ROTATION.

The advantages of O.E. Dever's system for pre-rotating the landing wheels with a view to reducing tyre-wear and strain on landing gears were described in the April, 1947, issue of " Interavia. " As will be shown, the greater the wheel's weight (mass) and the higher the landing speed, the more important it becomes. The empirical results obtained at Lockheed's provide some very clear indications in this respect. However, it is most informative to understand the physical processes at the moment of landing in theory and to determine the important factors of tyre detrition mathematically. The following lines by our collaborator, Dr. F. H., describe these ideas in a simple and lucid manner.

Regarded purely externally the process is simple : the stationary wheel is brought in a short time to a revolution rate corresponding to the landing speed of the airliner. Unless this speed is attained, the wheel scrapes the ground and subjects the tyre to enormous strain. If we are going to effect calculations with regard to this process we must first know of the extent of the friction, the state of the ground, the strength of the rubber, etc., or make corresponding assumptions as accurately as possible. On the other hand we can give a complete physical description of the occurrence if we confine ourselves to fundamental data and only consider the beginning and the end of the process.

We can therefore look at it in this way : the wheel is accelerated by a frictional force F attacking it at its periphery, thus at its radius r. The acceleration process requires a certain time, t. When it is finished the revolution rate of the wheel, which amounted to u_o before setting down, corresponds to the landing speed v_l, which means that the wheels no longer skid. Since landing, meanwhile, the aeroplane has covered the distance $v_l \cdot t$. The frictional force thus does the work A :

$$A = F.\ v_l \cdot t \qquad \text{(ft. lb.)} \qquad (1)$$

which is tapped from aircraft's kinetic energy. Of this, however, only a part is transmitted as acceleration work, B, to the wheel, while the remainder is used up in the detrition of the tyres and the ground. This detrition work C is therefore :

$$C = A - B \qquad \text{(ft. lb.)} \qquad (2)$$

To estimate it quantitatively, the peripheral force R is first determined by considering that its moment must be equal to the product of moment of inertia $(i^2 \cdot m_w)$ and angular acceleration of the wheel. The latter is calculated from the difference between the landing speed v_l and the revolution speed u_o of the wheel before landing, as well as from the radius r and the time t. In this way the magnitude of A is obtained. The acceleration work B corresponds to the differences of the kinetic energies of the wheels at v_l and u_o; and the detrition work $(A - B)$ proves to be proportional to the wheel mass m_w, to the mass distribution i/r and the square of the difference in speed (cf. equation 3).

With regard to the distribution of the detrition work on the wheel and the ground, two border cases are conceivable :

1) *If the ground is smooth and soft* the entire work C is absorbed by the ground ; the forces at the periphery of the wheel remain so small that they do not exceed the strength of the rubber and they leave the tyres undamaged.

2) *If the ground is hard and rough* (runway) its capacity to absorb energy is so slight that all is transmitted to the tyres.

The detrition work affecting the tyres can, if a variable factor k is introduced, be expressed as :

$$C_w = k/2 \cdot (i/r)^2 \cdot m_w \cdot (v_l - u_o)^2 \qquad \text{(ft. lb.)} \qquad (3)$$

In the first case $k = 0$, but in the second, $k = 1{,}0$; and all intermediate values occur.

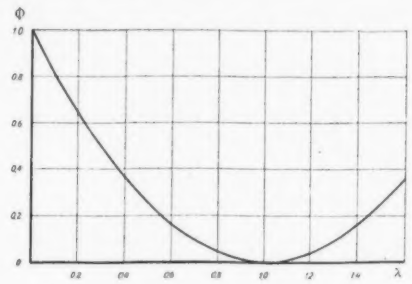
Since nowadays the second case is the more frequent and landing speeds are greater, tyre detrition is evidently a problem with which the aeroplane industry must grapple. Equation (3) corresponds to actual conditions, notwithstanding the apparent simplicity of its derivation.

The expression $(i/r)^2 . m_w$ in equation (3) deserves further discussion, for in first approximation the factor i/r is independent of the size of the wheel. In the case of a plane-surfaced full disc it would be entirely independent of the size of the wheel ; for a roller of small

diameter, for instance, it would have to be just as great as it would for a thin disc of large diameter. If, furthermore, the two bodies have the same weight, the said expression is equal in both cases, although the moment of inertia is much greater for thin discs. In consequence, therefore, if large and small aeroplane wheels (including their brake drums) are geometrically similar, larger wheels only increase the detrition work in proportion to their greater weight and not to their greater moment of inertia. On the other hand, the percentual proportions of wheel- and tyre-weight in the landing weight of an aircraft vary considerably as the size of the aircraft is increased.

Wear and tear due to friction, occurring at every landing, is independent of the duration of the acceleration process. It is therefore no use to accelerate the wheels gently for landing : since the wheel periphery is not infinite, every part of it is repeatedly exposed to friction, so that the total detrition ultimately amounts to the same. If the entire wheel periphery is not affected, local detrition is certainly somewhat greater for each landing. But as strain is put upon every part of the periphery the effects of the successive landings level out, provided that the wheel does not tend to one particular position owing to a bulge or a similar cause.

To protect the tyres from excessive detrition the revolution rate must be as great as possible. The wheels have to be electrically pre-rotated before landing or brought to the right revolution rate by utilising the relative wind. The success of this measure can be judged when we compare the detrition on pre-rotated wheels with that in the case of stationary wheels. We then obtain the following reduction factor for tyre detrition :

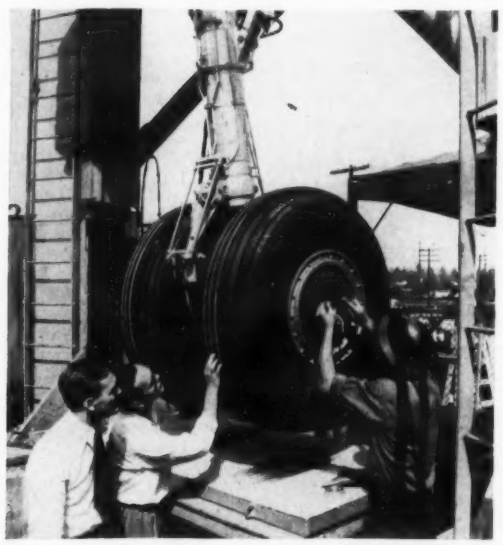


Reduction factor for tyre detrition at landing (ϕ) versus the relation of wheel peripheral speed to landing speed ($\lambda = u_o/v_l$).

$$\phi = (1 - u_o/v_l)^2 \qquad (4)$$

As this formula shows, pre-rotation is very effective : if $u_o/v_l = 0.6$, for example, detrition by friction is already decreased by 16 per cent.

This is as far as our collaborator takes us. That particular attention must also be paid to the damage caused to the tyres by heat from the brake drums, and that all efforts to absorb the speed energy of the landing aeroplane by using passive or even active engine power (reversible-pitch airscrews, etc.) instead of letting it be converted into heat, deserve special consideration, has been repeatedly emphasised in these pages.



The landing-gear drop-test rig installed at Lockheed's Burbank plant. The two photographs on the left show a " Constellation " landing gear with Goodrich tyres just after the drop. The wheels have been brought to a standstill by the tremendous friction (note the cloud of smoke). Observe also the lead weights and the simulation by calibrated metal straps of the lift furnished by the wing. In the left-hand photo, engineers are seen inspecting wear and tear on tyre covers and concrete stand after the drop experiment.

Views on the Armament of Modern Fighter Aeroplanes

By Gordon M. Gollob, formerly Colonel and Chief of Fighter Requirements, Luftwaffe. [1]

Contents:

I. Suitable inter-relation of calibre, muzzle velocity, rate of fire and weight of gun.
II. Ballistic aspects.
III. Long-range firing.
IV. Dispersion when firing on airborne targets ; number of hits required for destruction.
V. Influence of muzzle velocity and rate of fire on destructive probability.
VI. Acceleration conditions in attack flight ; their effect on firing.
VII. Advantages of an automatic-sighting device ; adjustment of guns.
VIII. Gun-sight-actuated trigger release ; target-tracking shells.
IX. Choice and limitation of calibre and type of ammunition.
X. Comparing 55-mm. rocket armament and 55-mm. cannon.
XI. Long-range guns for aeroplanes.
XII. Summary and conclusions.

When given a new type of fighter aeroplane to fly, the combat pilot will not only wish to know its flight performance data, but will also show particular interest in its armament and ask roughly the following questions :

How many and what type of guns ;
what calibre and how many rounds of ammunition ;
what firing power is available ?

As a rule this is all he will ask. On the basis of the answers he receives, he will then form his judgment on the combat value of the aeroplane. Meanwhile, he will have entirely overlooked the fact that, for assessing the armament, knowledge of a whole series of further data is of the utmost importance.

Experience in Germany showed that the average officer did not give much further thought to the matter than is mentioned above. The staff officer, however, has not only to think further but has to pursue his thoughts to a logical end. He will only be able to do this successfully if he possesses, alongside intelligence and sound military knowledge, a good amount of technical experience. He may not confine himself to examining a certain type of armament solely from the standpoint of its utility and qualities, in order thereupon to work out suitable tactics for the attack. *The primary duty of a staff officer is much more to direct science and engineering into channels, and to set requirements relative to development, such that only weapons which may be operated with a maximum degree of success will result.*

As a rule, the German staff officer of the last war did not form his judgment until the aeroplane in question had been terminated ; and, as experience frequently showed, his judgment was invariably incomplete. There was a shortage of officers with thorough technical and fighter-piloting experience in those appointments where they could have exercised a decisive influence at the right time, i.e., already at the time before a new fighter aeroplane had entered the blue-print stage.

On the one hand, statistics and cine-gun evaluation were not sufficiently practised ; on the other hand, the results were neither sufficiently observed, nor were they made good use of.

Based on actual experience, the following paragraphs aim to describe the considerations which must be made if the armament on a new fighter aeroplane is to fulfil its purpose entirely.

1. Suitable inter-relation of calibre, muzzle-velocity, rate of fire and weight of gun.

It has been established that an endeavour must be made to obtain as favourable an inter-relation as possible between the installation weight of a gun (weight of gun plus mount) and the weight (or number of rounds) of its ammunition. Since the maximum permissible total weight of gun plus ammunition is limited for each type of aeroplane, it is clear that, for a given installation weight, the ratio of gun-weight to ammunition-weight will become less favourable as the calibre of the gun increases. A few data relative to German types of aeroplane gun will serve to explain this point :

Gun	Weight	Calibre	Muzzle velocity
	kgs.	mm.	m/sec.
MG 151/20	44.5	20	700
MK 108	60.0	30	500
MG 213/30	75.0	30 or 20	550 (30 mm.)
MK 112.	270	55	600

As can be seen, the approximately 45-kg. weight of the 20-mm. gun increases to 270 kgs. in the case of a specially developed 55-mm. type, though both guns feature nearly the same muzzle velocity (the latter shall henceforward be called v_o).

However, if the v_o of the above 55-mm. gun is increased by about 50 per cent. to 900 m/sec., then it is understandable that the weight will be subjected to an increase which is utterly out of proportion. Thus, for example, the MK 214 A (50 mm., $v_o = 860$ m/sec.), which was admittedly destined for auxiliary installation only, weighed no less than 480 kgs.

It is therefore to be concluded that the *weight of the gun is very much contingent on the v_o specified.* Experience also shows that *increase of calibre and increase of v_o both entail a decrease in rate of fire.* That the German MG 213/30, a 30-mm. machine-gun, had a higher rate of fire (1,150 per minute) than the 20-mm. MG 151/20 (700 per minute) may not be taken as a refutation of this rule, since the MG 213/30 represents a peak performance in armament technique which has perhaps not yet been surpassed ; and in any case this would mean comparing two

[1] Successor to Colonel Galland, Gollob was the last to hold the post of "General der Jagdflieger" in the Luftwaffe.

guns in different stages of development. It seems to me that the 30-mm. calibre represents the type which can best meet the manifold requirements made of an aeroplane cannon.

The last German type of automatic cannon, the MK 112 featuring a calibre of 55 mm., had a firing rate of only 300 rounds per minute with a v_o of 600 m/sec., which clearly corroborates the statement I have just made. Meanwhile, it should be pointed out that, without altering the weight, the rate of fire can be varied within certain limits, though at the expense of v_o.

There is, therefore, a fixed inter-relation of calibre, v_o, rate of fire and weight of gun.

Taking into account the above relations, only if the tactical requisites are clearly recognised can technically-unsolvable problems be avoided, or, otherwise stated, only under this condition can high-quality armament be developed.

From the tactical angle, it should be indicated that—apart from other considerations—the magnitude of the v_o places a limit on the maximum distance from which an attack can be carried out.

Finally, the *gun-calibre* affects the size of certain aeroplane parts, in view of the *space* required for ammunition. If the space available in the structure is limited from the start, much less ammunition can be taken if the calibre is increased. However, the quantity of ammunition to be taken on board is in any case dictated by tactical requirements.

II. Ballistic Aspects.

The paragraphs below present some views on ballistics, knowledge of which greatly affects the quality of the development—provided, of course, proper application is made thereof.

I should first like to give a short account of conditions with regard to ballistics as they stood in Germany, in so far as they concern our subject. I think I may say that the development of German aeroplane armament had reached a high level, and that conclusions drawn from German data may safely be used as a basis for theories formulated with a view to interesting people of other nationalities.

Strong defensive armament, notably that of the Boeing B-17 " Flying Fortress, " soon emphasised the necessity of being able to launch attacks from greater distances. Greater distances, in this case, signify such of 800 to 1,000 metres. At these distances even armament as strong as that of the " Flying Fortress " is rendered relatively harmless to the attacker. Leaving out of account the additional velocity imparted to the projectile by the speed of the fighter aeroplane (subsequently called v_e), at 1,000-metres range the projectile's trajectory has a vertical component of nearly 30 metres at low altitude in the case of the MK 108, and one of 10 metres for the MK 103. Understandably, therefore, the MK 108 could not be used at this range. In principle, however, both these guns could be used if the vertical components of their respective trajectories were adjusted with sufficient accuracy by suitably inclining the automatic sighting devices. Although this would be possible, there are other reasons why this attacking range could not be used.

Owing to the decreased density of the air, a noticeable flattening of the trajectory occurs at high altitudes. At an altitude of 10,000 metres the vertical component of the trajectory of the MK 103 projectile at 1,000-metres range decreases by 1.5 metres, thus amounting to 8.5 metres. For the MK 108 the vertical component at this range amounts to 22.3 metres instead of the 30 metres at low altitude.

Meanwhile, the fact that the aeroplane's speed v_e adds to the velocity of the projectile invariably involves a further flattening of the trajectory. Taking this factor into account, at 10,000-metres altitude the vertical component of the MK 103 projectile at 1,000-metres range only amounts to about 5.5 metres and that of the MK 108 projectile to about 11.2 metres.

At the altitudes around 15,000 metres which we would have to reckon with in a future event, the further decrease in air density would involve a further flattening of trajectories, which would of course signify an improvement—from the ballistic angle.

It may therefore be inferred from the above that a gun which from the ballistic standpoint works unsatisfactorily in ground vicinity can, thanks to its flatter trajectory at great altitudes, be made to give better results over longer ranges if it is suitably adjusted or provided with an automatic sighting apparatus adapting itself to the new trajectory. Then it should not be overlooked that a gun adjusted to 1,000 metres at low altitude would considerably overshoot the target at an altitude of 10,000 metres.

To give a further illustration of the points maintained above, in Figure 1 the trajectories pertaining to the MK 103 (v_o = 860 m/sec.) and to the MK 108 (v_o = 500 m/sec.) for low altitude and at 10,000-metres altitude are shown both *with* and *without* v_e taken into account, assuming v_e to be 200 m/sec. The decrease in vertex at 10,000-metres altitude as a result of the v_e is an influential factor. At 10,000-metres range the vertex decreases from about 8.5 metres to roughly 3 metres for the MK 108 projectile and from 2.8 metres to about 1.5 metres for that of the MK 103, the vertex usually being attained at about 500 metres. Consequently, if a fixed sighting apparatus were used at this range, the target would be overshot if it projected only slightly above the aiming point.

It is therefore not enough for an automatic sighting device only to compensate the ballistic trends. It must simultaneously provide for correction of the two above-mentioned flattening factors.

III. Long-range firing.

As already stated, the augmented defensive power of combat aircraft in general makes it necessary to conduct attacks from increasingly greater distances. Therefore the question is repeatedly raised, whether firing over such great distances will become possible. A " great distance " shall be understood here to be one from which the attacker —taking into account the defence action which he will encounter—has the optimum chance of destroying his objective. The armament must be disposed in such a way that the opponent can be *shot down in the shortest*

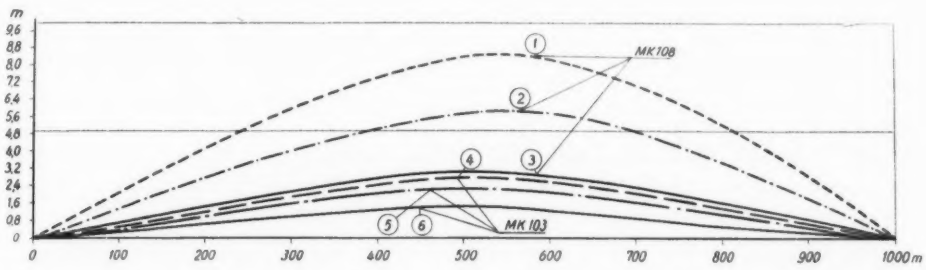
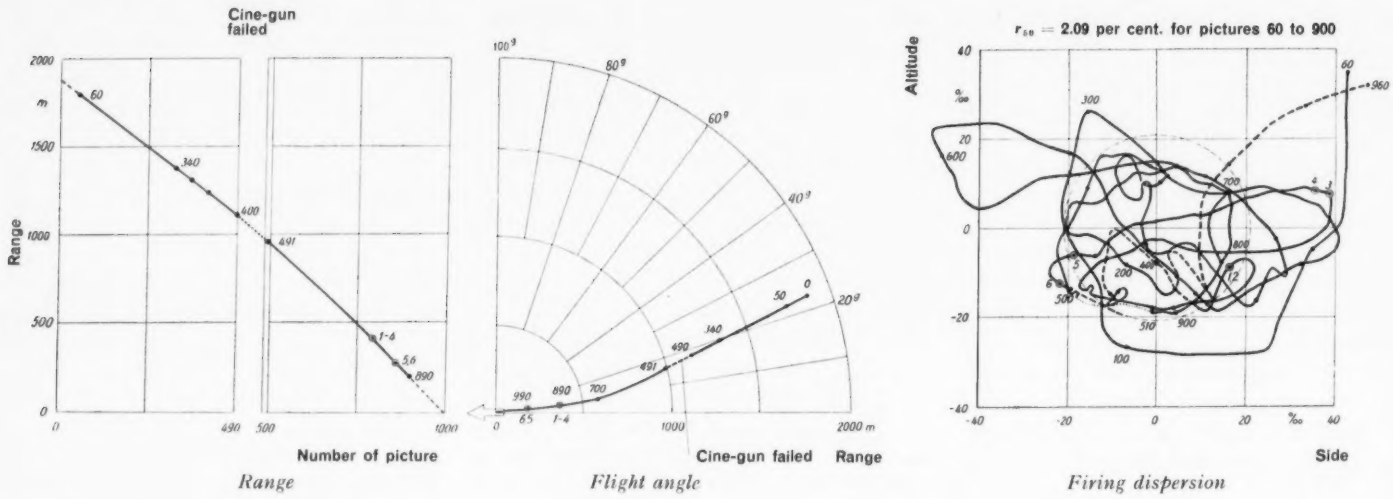


Fig. 1: Trajectories for the MK 103 and MK 108 automatic cannon at different altitudes
(Based on Luftwaffe firing tables ; system of axes fixed relative to the ground) :

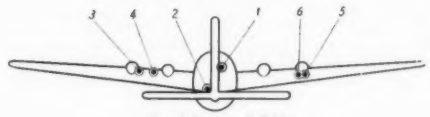
Flight path	Gun	Altitude	Own aeroplane's speed v_e	Muzzle velocity v_o	Height of vertex y_s	Distance of vertex x_s
		kms	m/sec.	m/sec.	metres	metres
1	MK 108	0	0	medium	8.45	540
2	»	10	0	»	5.85	530
3	»	10	200	500	3.04	510
4	MK 103	0	0	medium	2.80	510
5	»	10	0	»	2.20	508
6	»	10	200	800	1.50	500



Range *Flight angle* *Firing dispersion*

Fig. 2: Example of an air duel

An Fw 190 with fixed sights attacks a " Fortress II " from the rear. Firing dispersion, 2.1 per cent. ; fire opened at 1,800 metres and flight angle of 25 deg. ; successful shooting at 400-metres range and below, at flight angles of less than 10 deg. Fw 190's armament comprised 4 MG 151/20 and 2 MG 17 machine guns. Only hits with high-explosive and incendiary ammunition were evaluated. The numbers from 1 to 6 refer to the hits and the other figures (0 and 60 to 990) to the cine-gun pictures.



Positions of hits

possible time with the minimum of risk to the attacker.

In this connection the view is frequently advanced that increasing the fighting range necessitates raising the muzzle velocity of the projectile—v_o. In the light of experience gained (especially since the introduction of automatic sights of the EZ 42 type), this opinion can be condemned as incorrect.

Impartially evaluated experience has taught the following :

a) Adequate projectile efficacy being assumed, *the rate of fire* (and *an automatic sighting apparatus* such as the German EZ 42 mentioned above) can contribute in a large measure towards the success of fighter operations ;

b) merely raising the muzzle velocity v_o of aeroplane guns will inevitably turn out to be to the detriment of the destructive probability since it involves increasing the weight of the gun and decreasing the rate of fire.

IV. Dispersion when firing on airborne targets ; number of hits required for destruction.

The extent of dispersion is contingent on a technical and on a human component. It is of cardinal importance that dispersion be combatted in every possible way. This is true without qualification, even if dispersion or any other kind of error in aiming happens to turn out well under individual circumstances : other kinds of error would occur, for instance, when a gun which, owing to bad setting, overshoots its target at great altitudes, but when firing with rigid sights in a curved-path air duel, provides for perfect correction of the " lead " which, as experience shows, pilots are continually apt to underestimate. During the War frequent use was made of *diverging adjustment.* In this instance, fire was simply spread over a larger area. It could be referred to as inherent dispersion over which the pilot had no control. The object was certainly to increase the probability of a bad gunner's hitting the target. And it is true that the method often succeeded, but diverging adjustment is obtained at the price of *decreased firing density* and so cannot be accompanied by real success. It is of course very desirable to cover as great an area as possible with any type of armament, but this should not be done by simply dispersing the fire without taking measures to preserve its density. This method of adjustment would not permit the pilot, even if he really scored a success, to be certain that he had fired accurately, because the fact would have to be taken into account that the divergence may have been responsible.

Practice shows that optimum results can only be expected when the pilot knows that his gun is *firing where he has aimed it* ; only in this case will he be able to profit by his hard-won experience.

Evaluation of German cine-gun films showed that the result of firing (with rigid sighting devices) was particularly affected by two kinds of dispersion, of different magnitude but always present :

a) firing dispersion (symbol—r_{50})

b) lead dispersion (symbol—V_{50})

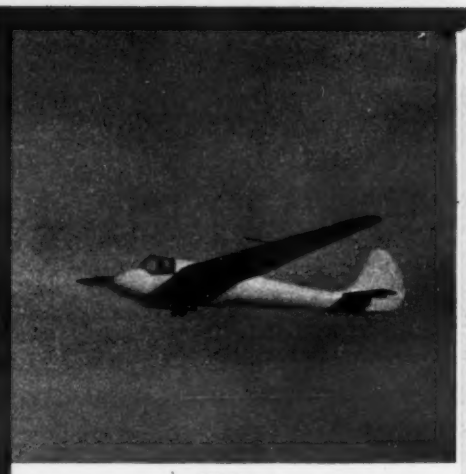
Firing Dispersion : The best gunners place about 50 per cent. of their fire within a circle with a radius of 0.8 per cent. of the firing range ; average shots place 50 per cent. of their fire within a circle with a radius of 1.5 per cent. of the firing range. In the latter case this means that at 1,000-metres range the circle, within which *half* the fire is placed, is 700 square metres in area. On the other hand the silhouette of a " Flying Fortress " from in front or behind has an area of only about 30 square metres.

Figure 2 shows the evaluation of an attack made by a Focke-Wulf Fw 190 fighter, equipped with a cine-gun camera and rigid sighting apparatus, from behind on a " Flying Fortress. " The firing dispersion r_{50} amounted to 2.1 per cent. and hits were scored at 400-metres distance with flight-path angles of less than 10 deg. Fire was already opened at a distance of 1,800 metres. It is a feature of a great number of cases that fire was opened at far too great a range, and it therefore constitutes a warning not to be too economical with the ammunition supply.

To be continued next month.

Some French Aircraft Types now in Production

C. 800 GLIDER
Two-seater trainer



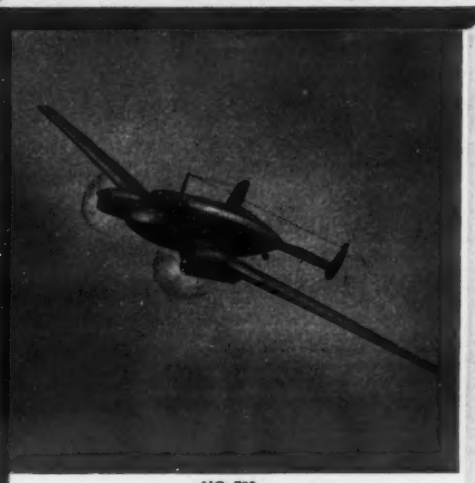
AIR 100
High-performance sailplane.

SIPA 90
Two-seater training and touring aircraft.

NORD 1200 "NORECRIN"
Three-seater personal aeroplane.

SUC 10 "COURLIS"
Taxi or personal aircraft.

MORANE-SAULNIER 472
Two-seater fighter trainer



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Taking Off Through the Ages

From Icarus to Jato

The history of aeronautics, from the ancient times of Icarus to the latest era of rotary and rocket power, reveals that designing a heavier-than-air craft has always presented two main problems : devising a machine capable of flying and, what is more difficult, getting it airborne.

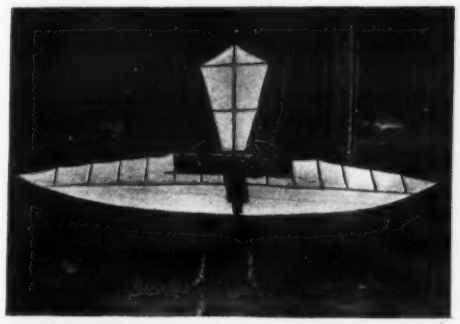
Early inventors were frequently inspired by the certain knowledge that their constructions were capable of flying. But how enormous the problem appeared when it came to taking off ; and how often it occurred that machines, perhaps otherwise capable of flying, could not be coaxed into leaving the ground at all.

Paradoxical as it may seem, it is perhaps quite logical that the pioneers failed to conquer the take-off problem. By a fanciful turn of mind, we might maintain that certain principles of aerodynamics were known long before the law of gravity. Leonardo da Vinci realised the potentialities of a horizontally-rotating fan as a means to produce lift in 1480 ; but it was only towards the turn of the XVIIth century that the legendary apple rapped on the head of Sir Isaac Newton, reminding him to give us his Law of Gravity and his Laws of Dynamics. Then, it is understandable that designers did not stumble on the idea of the "flying start," using forward speed for taking off, since their first inspiration was of course the bird—which, like a helicopter, rises from the spot.

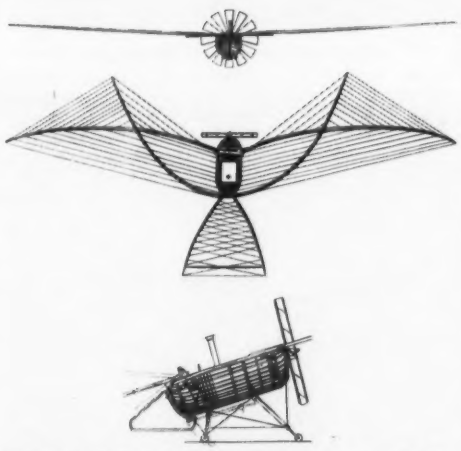
In actual fact, the first heavier-than-air device to lift itself off the ground was a helicopter (this word was not coined until about 1860). It was a small flying model built in 1784 by two Frenchmen, *Launoy* and *Bienvenu,* which comprised two four-blade airscrews, consisting of feathers, mounted at either end of a vertical shaft ; rotation of the airscrews—presumably in opposite directions—was accomplished by means of a strip of metal which, spanned like a bow, wound off a thread coiled about the shaft. But in their enthusiasm to take off, these two gentlemen omitted to provide a means of forward propulsion.

In 1796, the English inventor, *Sir George Cayley,* who was the first to combine aerodynamic principles into flight, also used Launoy and Bienvenu's bow and string as a source of energy, but set his rotor-blades at scientifically-calculated angles of incidence. In 1843, nearly fifty years later, he proposed a twin-rotor helicopter, but this time additionally equipped with two pusher-airscrews for forward propulsion. Though it was never built, the sound aerodynamic principles on which it was based, together with Cayley's model glider of 1809 and his remarkable descriptions of the modern aircraft, published in 1809 and 1810, have since earned him the honour of being the real inventor of the aeroplane. But his conceptions of the take-off did not extend beyond rotary wings and aerostatic means.

Launoy and Bienvenu's tiny helicopter of 1784 was the first heavier-than-air flying machine to take off under its own power... but it could not fly forwards.



Stringfellow's model monoplane of 1848 was the first mechanically-driven aeroplane to fly... but it would not take off and had to be suspended from a wire cable.



Aeroplane patented by Felix du Temple who built in 1857 the first pure aeroplane (model) ever to take off by its own power.

Subsequently there commenced what might well be dubbed the "aeronautical steam age." Tapping Cayley's reservoir of aerodynamic theories, another Englishman, *W. S. Henson,* patented in 1842 a project for a steam-powered aeroplane with a large single wing and two pusher airscrews—the "Ariel." Wing loading was to have been about 0.5 pounds per square foot and it was to have been powered with a twenty-horsepower engine. A small model was tested without success, and no full-scale experiment was tried, but Henson's prophetic design is regarded as one of the chief links between Cayley's models and the modern aeroplane. Continuing in Henson's footsteps, *John Stringfellow* then built his famous model monoplane of 1848, powered with an improved steam engine and recorded as being the first mechanically-powered aeroplane ever to have flown. But it did not take off either ; from the beginning it had to be suspended from a wire cable. And this English inventor's triplane, evidently built with the idea of obtaining more lift, also refused to take off : rather understandably, since the power loading was roughly 100 pounds per horsepower and the wing loading about 1.2 pounds per square foot. (A modern Hawker "Fury" fighter, for instance, has a power loading of 4.6 pounds per horsepower and a wing loading of 50 pounds per square foot.)

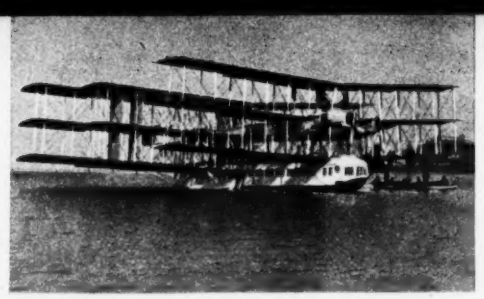
The first pure aeroplane, that is to say, not incorporating any rotating-wing or aerostatic principles, ever to lift itself off the ground by its own power, was a small model built in 1857 by a Frenchman, *Felix du Temple*. It was clockwork driven and, according to the inventor, "once the engine had been started, the airscrew pulled the entire machine along with sufficient speed for the vertical component of the air resistance to become stronger than the weight of the machine." Du Temple showed remarkable foresight by making provision for light metals and various types of power plant in his patents, but he never attempted any full-scale tests.

Ponton d'Amecourt's steam-driven helicopter (1863) was only one of many attempts to conquer the skies in the last half of the XIXth century.

Aeronautical history of the subsequent half-century is dotted with brave and clever experiments to conquer the skies. Whilst aerostatics was the favourite science, much was achieved in the field of heavier-than-air designing. That the take-off problem was foremost in inventors' minds is evidenced by the many freakish but sometimes moderately successful model helicopters and ornithopters that were built, which showed that some still believed strongly in bird-flight principles. Though the aerodynamic progress was enormous—*Lilienthal* showed the importance of cambered aerofoils, *Horatio Philips* introduced the wind tunnel and the dipping leading edge to reduce drag, *Octave Chanute* had laid the basis for automatic stability—the take-offs were all very tedious and unsure.

In 1903, the *Wright Brothers* acquired the honour of being the first to fly in a mechanically-driven heavier-than-air machine. But, in a way, their real honour is to have been the first to have taken off in an aeroplane, since many of their predecessors' constructions might very well have flown if they had been suitably launched into the air streams. And the Wright Brothers actually did resort to external assistance during the take-off, initially propelling their aeroplane by attaching it to a cable and pulley system, actuated by a falling weight. *Professor Samuel Pierpoint Langley's* experiments in the U.S.A. around the same period, when he twice attempted to catapult his piston-powered biplane off a house-boat in 1903, ended in disaster, though the aeroplane was sound in design and the engine built by his assistant, Charles Manly, counts among the marvels of engineering history. In 1901, an Austrian piano manufacturer with a flair for engineering, Wilhelm Kress, was the first to attempt a take-off in a seaplane powered with a piston engine. Unfortunately, the machine hit a rock whilst gliding over the water, perhaps carrying to the bottom of the Pressbaumer Lake the laurels which the Wright Brothers gained two years later. It is claimed by many that Clément Ader's "Eole" actually did take off in 1890, and flew 150 ft. And so the list goes on, featuring a multitude of aeroplane designs that had all it needed for flying, but evidently not for taking off. The more advanced types which came after the Wrights frequently did well once they were in the air; but it was invariably a long if not a difficult and hazardous task to coax them into leaving the ground.

Lacking compact, high-performance aero engines of small frontal area, designers, in their ignorance of streamlining, concentrated primarily on low wing loading; in consequence the drag coefficients of those days were sky-high. The first design to resemble a modern aeroplane was perhaps that built in 1910 by *Edouard Nieuport*, the famous French aeronautical engineer and manufacturer. A monoplane with entirely covered fuselage, it was certainly the first streamlined aeroplane; and it flew at 75 m.p.h. But little heed was taken of his lesson, for there was a strong tendency to break away from Nieuport's conception and to return to the cumbersome



Lift coefficients were high, but drag coefficients were high too! Caproni's "Capronissimo" nine-plane flying-boat which flew but met with disaster in 1921.

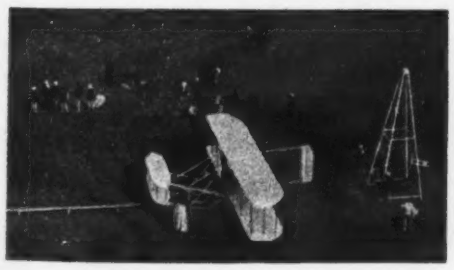
"all-lift, flying-kite" types; and there were still many who stubbornly maintained their belief in the ornithopter.

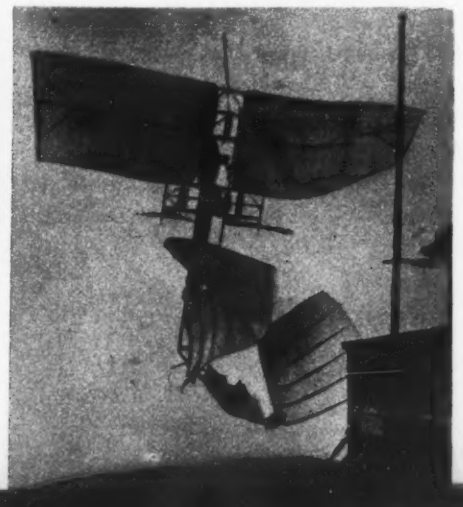
At all events, a great deal of ingenuity—and daring—was dispayed in devising auxiliary launching methods; which, however, only went to prove that there was still much to be learned. The use of flaps for the take-off was unknown, and a popular method up to the first World War was for the pilot to give maximum throttle while half a dozen men held the tail down and another two held each wing tip. Otherwise, biplanes, triplanes, quadruplanes, and generally freakish constructions were conceived in order to produce lift and hasten the take-off before the entire fuel reserve had given out.

Ingenuity—and imagination—was displayed in the early methods of assisted take-off: M. P. Roux's launching rail of 1904.

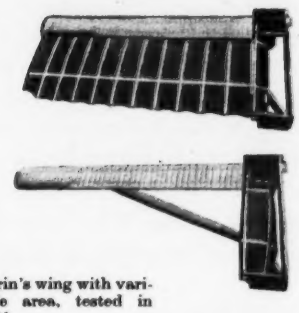
Only during the two years preceding World War I did streamlined fuselages and airscrew spinners begin to appear in monoplanes, but the desire for short take-off distances kept the multi-winged design in fashion right through the war years. A certain amount of aerodynamic refinement was achieved—notably by Junkers, who started building all-metal low-wing monoplanes of stressed skin construction as early as 1918—but the monoplane was not universally accepted until much later, with the advent of flaps, variable-pitch airscrews, and engines of low weight/power ratio.

The Wright Brother's system of assisted take-off won them eternal fame... but Langley might have snatched their laurels if his take-off system had not failed him.





Makhonine's telescopic-wing monoplane, tested in 1931. (Maximum span was 21 metres and minimum span, 13 metres.)



Gérin's wing with variable area, tested in 1931.

It is difficult to say exactly when flaps were invented. The earliest types of ailerons could be used simultaneously as flaps, and it is likely that the principle of wing warping also led up to the idea. The basic notion in designers' minds was to increase the wing area at take-off in order to obtain more lift ; and it is probable that the flap proper was originally introduced to permit landings at high wing loading. The earliest form was the camber-increasing flap, which was hinged along the entire trailing edge of the wing ; and it was not until some time later that the slotted leading and trailing edges made their appearances. The "slot, slat and slit" era, which is by no means at an end, features many famous names, such as Handley Page, Lachman, Fowler, Junkers, Youngman, etc.

The first streamlined aeroplane, built in 1910 by Nieuport, was a definite step forward.

Meanwhile, there also appeared a number of other "high-lift" devices, ranging from practical to nonsensical. All, however, were conceived with the same object in mind : to increase the lift without involving too great a penalty as regards drag. There was the Makhonine telescopic wing, the venetian-blind flap, the Irving split monoplane (which took off as a biplane), the Hall wing (likewise based on the temporary biplane idea), the tilted thrust-line conceived by Crouch and Bolas (with the engines distributed over a wide span so that the slipstream could cover the entire wing), and other systems. Another field to which a great deal of attention was paid in the few years before the last war—and is still the object of interesting and intense research—was boundary-layer suction. All these ideas revealed a high degree of ingenuity, but many were dropped because they presented considerable structural difficulties, and probably also because the general interest was not great enough.

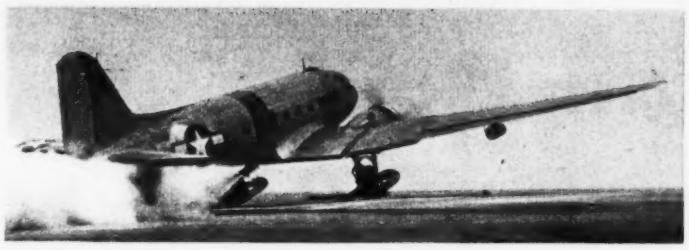
A factor that greatly simplified the take-off problem was the *high-performance engine*, which simply enabled high take-off accelerations and reasonable power loadings to be attained. Then a multitude of contributing factors made their appearance : drag was reduced by streamlining both airframe and engine ; light alloys, which enabled the weight to be cut down ; variable-pitch propellers, which allowed the new engines to be used to their fullest advantage ; retractable and tricycle undercarriages ; and last but not least, runway surfaces were greatly improved. In short—though at the expense of much labour and ingenuity—the aeroplane as we understand it today was born : capable of taking-off (and landing) surely, smoothly, within reasonable distance.

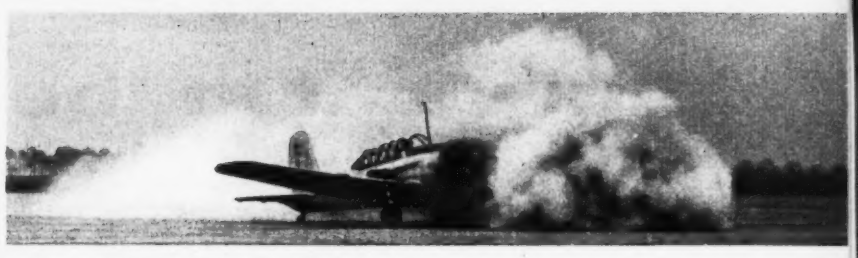
The last war fostered the development of the heavy bomber and the heavy transport. We knew how to streamline them and power them sufficiently well to make take-offs possible. But, understandably, take-off distances must necessarily assume alarming proportions with the advent of such gross weights, notably since wing loadings, as a result of structural progress, are at present made high in the interest of commercial operations. It is a fact that aerodynamic refinements enable high lift to be obtained at take-off without increasing the drag all too much. But when airliners take on a size like the Boeing "Stratocruiser" and require take-off runs of over 5,000 feet, then it is high time for engineers to put on their thinking caps and devise some auxiliary means of shortening take-off distances. Otherwise, aerodromes have to be enlarged, which, for obvious reasons, is not always practical, and is sometimes impossible.

Though the assisted take-off has been rather a focal point of interest since the War, it is by no means a new field. In fact it is as old as the history of flight—as old as Icarus. Naval aviation perhaps gave it its first real impetus, when aeroplanes were catapulted off aircraft carriers. Here, however, the "g" problem arose : if the take-off acceleration is greater than that of gravity (9.81 metres/sec^2.) the pilot is subjected to a certain amount of unpleasantness. As usual, however, the pilot is expected to put up with it ; but what about the paying passengers ? Definitely not ! —the catapult had to be struck off the list as far as commercial aviation was concerned.

Then came what might be called the "detachable high-lift devices." The scrap-wing, for example, was an auxiliary jettisonable wing attached to a monoplane ; the aeroplane would take off as a biplane, shed the scrap-wing, and fly on as a monoplane. Besides the obvious danger of the falling object, there was the added disadvantage of the expense : the jettisoned structure was entirely expendable. The well-known Mayo composite aeroplane comprised a large flying-boat with a small seaplane mounted on its back ; after the flying-boat had taken off, the seaplane could be released, thereby increasing its range and allowing for a take-off under conditions

The idea of the Short-Mayo composite aircraft was to allow for take-offs at higher wing loadings and to increase the range.





JATO rockets for short take-offs (DC-3 off an aircraft carrier) and short—but dusty- landing runs (Consolidated BT-13 "Valiant").

of higher wing loading than otherwise. Another idea involved a similar principle, but with a smaller secondary aeroplane, a powered scrap-wing in fact, attached to the back of the main aircraft in order to aid the take-off. Meanwhile, structural difficulties and the high expenses invariably sufficed to cut these projects short.

Obviously, designers thought, the most logical method was still to increase the take-off speed. But how to do it *gently*? Again, this field turned out to be an inventors' paradise; and the projects which unfolded were like something borrowed from H. G. Wells. An American, Emile Doehler, was perfectly serious when he proposed a streamlined locomotive running on a wide-gauge rail around the aerodrome; with the airliner suitably perched on its roof, it could impart an acceleration more gentle than that of gravity. Several countries experimented with improved versions of the Wright brothers' cable-and-weight system. Even rolling runways were tested in England and the U.S.A. during the last war. Many of these projects were sound enough, but too costly and cumbersome. The universal call was, and still is, for cheapness and simplicity.

Just as in the case of unassisted take-offs, this call was again answered by the higher-performance engine—but this time the *rocket and jet engine*. In Germany, Opel had made successful short hops in rocket-driven gliders; Caproni, in Italy, had demonstrated the potentialities of jet propulsion; and it was known during the War that heavily-loaded Junkers Ju 88 bombers were being whipped off the ground with the aid of rockets.

Whittle's gas-turbine data were given to the U.S.A. during the War, and Westinghouse built the Model 19A, predecessor of the famous 19B "Yankee," and flight-tested it as an auxiliary power unit beneath the fuselage of a Vought "Corsair" fighter. Besides increasing the climbing performance, it considerably shortened the take-off run. This and other experiments pointed the new way ahead for assisted take-off research.

The very latest method of assisting take-offs is known by four familiar letters, JATO (standing for Jet-Assisted Take-Off), developed during and since the War by Aerojet Engineering Corp., of Azusa, California. A rocket engine weighing 205 lbs. (115 lbs. empty) and developing 1,000 lbs. of thrust over a period of twelve seconds, its action does not accelerate the aeroplane too violently, and enables the normal take-off run of a loaded Douglas DC-3, for instance, to be cut down by almost 25 per cent. Its advantages are manifold, in that the rocket charge could be reduced for small aeroplanes (and gliders), several JATO units can be attached for heavy types, and there is plenty of room for improvement by finding new propellants. Then, it can also be used for shortening landing runs, which might prove advantageous in the case of pure jet aircraft, where reversible-pitch airscrews cannot be used. Though the U.S. Civil Aeronautics Administration has granted a certificate for its application to civil aviation, a poll recently undertaken by the Air Transport Association of America showed that U.S. airline companies regard JATO as impracticable. Meanwhile, it seems unlikely that this rejection will be taken as final by the manufacturers, and not met with improvements on the system.

Prying into the future can be a very hazardous undertaking. Will JATO be improved, superceded? Will some of the early cast-aside ideas be taken up again and developed? Will the old and new be combined? We have already seen that all the take-off problems cannot be solved with the aid of JATO rockets. Special research aeroplanes—readers will recall the case of the Bell XS-1 rocket-driven experimental supersonic aircraft—have to be carried aloft by large transports and released once a safe altitude has been reached. It is clear that the newest types, powered by pure jet-propulsion engines which only run satisfactorily in the vicinity of sonic speed, will call for entirely new take-off methods if they are to prove successful and find universal acceptance.

And then there are many other fields which might be applied to assisting take-offs. Flight-refuelling and pick-up methods could in a way be used, since in both systems the load is increased once the aeroplane is on the wing. Or—how about using the landing-wheel pre-rotation idea for increasing take-off acceleration? One might ask what atomic energy holds in store for aviation. There is the supersonic era ahead—perhaps only just around the corner. And maybe we shall see, in our life-times, conservative travel agencies advertising: "See your own planet first!"

Sa.

JATO cannot yet solve the take-off problem in the case of special high-speed research aircraft. The Bell XS-1 supersonic plane, which pierced the sonic barrier last Autumn, had first to be carried aloft by a B-29 "Superfortress."

Developed for the U. S. Navy by Westinghouse Electric Corp., this electric catapult, or "*Electropult*," is essentially an ordinary electric motor of which the rotor is laid out flat on the ground to form a 1,382-foot track for the stator, here represented by a small shuttle car to which the aircraft is hitched. Successive energisation of the rotor's 17,000 copper bars have already sped the small car down the track to launch a jet fighter at 116 m.p.h. in 4 1/10 secs. after a run of only 300 feet; normally, the plane would have required 2,000 feet. Similarly, it is hoped to launch airliners requiring 4,000-feet take-off runs, at 120 m.p.h. after only 500 feet, maximum acceleration being 1 g, which would be built up during the first two seconds.

Survival in the Air Age*

This is the title of one of the most important documents on the defence of the U.S.A. ever prepared in time of peace. It was submitted to President Truman on January 1st, 1948, by his temporary *Air Policy Commission* which, composed of five prominent U.S. private citizens, was appointed by the President on July 17th, 1947, under the chairmanship

President Truman's Air Policy Commission : George P. Baker, Vice-Chairman ; Arthur D. Whiteside, Member ; Thomas K. Finletter, Chairman ; John A. McCone and Palmer Hoyt, Members.

of *Thomas K. Finletter,* New York lawyer ; he was assisted by four experts on transportation, economics and industry, as well as a newspaper man. Recognising that technical progress was outdistancing American air policy planning at an increasing rate, the President charged the Commission with making such recommendations as "will serve as a guide for formulating a carefully-considered national air policy." The report is divided into five sections :

Section I. Air Power and the National Security : In view of the fact that the U.S.A. will be secure only if the institution of war itself is abolished, unilateral disarmament by the United States is out of the question. Abroad, the U.S.A. must have a double-barrelled policy : it must work to achieve world peace through the United Nations, and it must defend itself for the possibility that war may come. Whilst the Navy has hitherto been the main defence of the United States, *a new strategic concept, based on air power, is now needed.* For strategic purposes, the future should be divided into two parts : the present Phase I, during which the U.S.A. has a monopoly of atomic weapons, and Phase II, the time when other nations will have sufficient atomic weapons to carry out a sustained attack on the U.S. Navy. It would be an unreasonable risk to assume that other nations will not have supersonic bombers in quantity, with a striking range of 5,000 miles, or accurate supersonic guided missiles, with a 5,000-mile range, enabling them to deliver a sustained attack on the United States by the end of 1952. Furthermore, the possibility that biological weapons may be used in all-out attack on the United States should not be overlooked. During Phase I a major war seems unlikely, but any attack during Phase II would be extremely violent ; the U.S.A. therefore needs a counter-offensive air establishment capable of retaliating with the utmost vigour.

Even for Phase I, the present strength of the Air Force is inadequate, but in respect of the future Phase II period it is *hopelessly wanting.*

Hence, the Air Force must be increased from its present level to a minimum establishment of 70 groups with 6,869 first-line aircraft, an Air National Guard of 27 groups with 3,212 first-line aircraft, and an adequately-equipped Air Reserve of 34 groups ; there should be a reserve of 8,100 new aircraft. The programme should be started now and completed before the end of 1952.

The Navy Air Arm, as presently constituted, is adequate, but its World War II aircraft, now rapidly becoming obsolescent, must be replaced.

The current budget (year to June 30th, 1948) for the Armed Forces must be increased. For example, the Air Force funds of $2,850,000,000 should be raised to $4,150,000,000 for the calendar year 1948 and to $5,450,000,000 for the calendar year 1949.

Section II. The Aircraft Manufacturing Industry : Two production levels are considered to provide a safe basis for the industry's expansion in emergency. The lower level, based on the assumption that world peace was well assured, provides for military purchases of 30,000,000 lbs. of airframe weight annually. The higher level, adopted for the event that the United States needs a substantial striking force at all times, requires military purchases of 60,000,000 lbs. annually. At the present moment, purchases of 3,040,000,000 lbs. annually would be adequate (present rate is about 21,000,000 p.a.)

Section III. Aeronautical Research and Development : The commission states that fundamental research in the aeronautical sciences were practically abandoned during World War II in favour of development of existing types of aircraft for production. By VJ-Day America's reserve of research information was largely exhausted. Research in the following fields should be intensified immediately : subsonic and particularly supersonic aerodynamics, gas turbines, rocket engines and piston-type engines, blind-landing equipment.

New research personnel should be trained and their salary-ceiling raised in order to attract top-calibre scientists. The sixteen supersonic wind tunnels planned by the National Advisory Committee for Aeronautics (NACA) should be installed as quickly as possible. Finally, war-time security measures should be rigidly enforced.

Section IV. Civil Aviation : In order to prevent deterioration of airline service to the public and maintain a potential military auxiliary, the airlines must be kept strong and healthy. For this purpose the following recommendations are submitted : increase of mail rates, carriage by air of all first-class mail, inauguration of air parcel post ; increase of airline safety, e.g., by operating new types of transport aircraft regularly on non-passenger schedules for a specified mileage before passengers are carried ; increased regularity, establishment of a nation-wide system of air traffic control. Existing and potential traffic should not be spread among too many separate carriers. Competition among American international operators should be retained and feeder lines should be extended.

Section V. Government Organisation : Paralleling the organisation of the Navy, Army and Air Force Departments under the Defence Department, a *Secretary in charge of a Department of Civil Aviation* should be appointed immediately under the Secretary of Commerce. The position of Administrator of Civil Aeronautics should be abolished. An Air Safety Board should be established and the Civil Aeronautics Board increased from five to seven members. Alongside the Secretary of Civil Aviation should be set up a *Secretary of Industry and Trade,* under the Secretary of Commerce. Some time within the future, a *Department of Transportation* should be created, which would succeed the Civil Aviation Department.

The report submitted to the President of the United States so far assumes merely an advisory character. Coincidentally with the appointment of the President's Commission, U.S. Congress established its own investigation body, the *Congressional Aviation Policy Board.* Composed of five Senators and five Representatives, it is to complete its report by March 1st, 1948. It is probable that the quintessence of the two reports will exercise a profound influence on the direction of America's growing re-armament in the air.

* Reprinted from "INTERAVIA, International Correspondence on Aviation", the illustrated aeronautical news digest published three times weekly.

Britain's 140-Ton Giant Flying-Boat

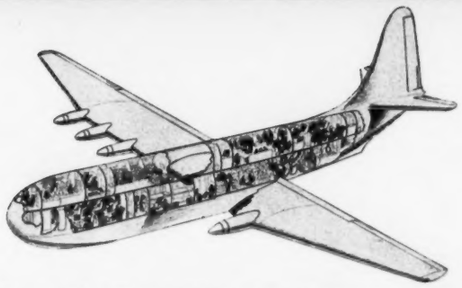
Saunders-Roe SR/45

Regularly plying the long Empire routes, flying-boats have for years maintained Britain's air links with South Africa, India, Australia and New Zealand; and only in the face of wartime requirements were landplanes first operated over the North Atlantic. In consequence, there has never been a dearth in Great Britain of staunch supporters of the flying-boat. Their common argument is that above a certain weight category, of about sixty to eighty tons, the flying-boat's shortcomings, as compared with the landplane, diminish and, on the whole, still heavier flying-boats are superior to landplanes as a commercial proposition for long-distance operations. The reasons for this ascendency are manifold: with increasing weight the flying-boat's aerodynamic efficiency and structural weight gain steadily in relation to those of landplanes; and the flying-boat's seaworthiness improves simultaneously. Moreover, the penalties incurred by progressively heavier undercarriages and the difficulties of providing larger aerodromes with specially-reinforced runways are circumvented by flying-boats.

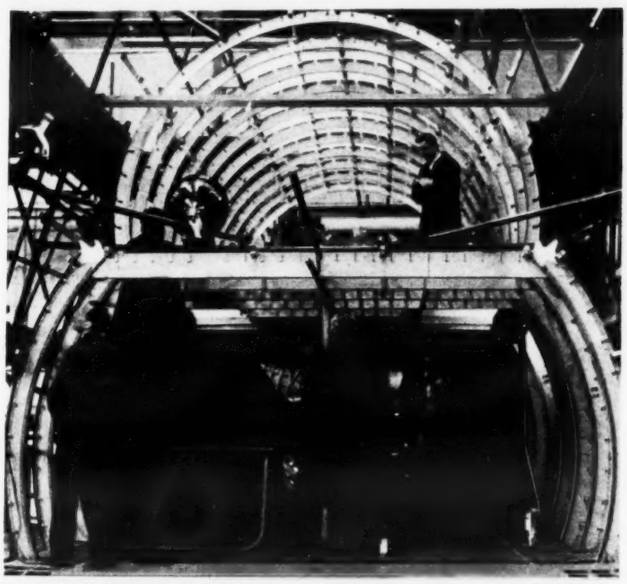
On the basis of these considerations the well-known British firm of marine aircraft engineers, Saunders-Roe Ltd., of East Cowes, Isle of Wight, started in May, 1946, on the construction of three 140-ton long-range civil flying-boats. Known for the time being under the designation of SR/45, the first one is expected to be ready for flight trials early in 1950. Power is to be supplied by ten Bristol "Proteus" airscrew-turbines of 3,500 H.P. each, with eight paired in four groups to drive contra-rotating airscrews and the other two mounted singly in the extreme-outboard nacelles. The intended fuel supply of 15,000 Imp. Galls. will amount to nearly 40 per cent. of the all-up weight. Spanning 220 feet and measuring 146 feet from stem to stern, the SR/45 will be able to carry up to 100 passengers at a cruising speed of 350 m.p.h. It will be the first flying-boat to feature a double-deck, figure-8 hull, pressurised and air-conditioned throughout. A maximum range of 5,500 miles make the SR/45 appear ideally suited for bridging the long stages of the Empire network.

It is not aimed here to enquire into the sums already expended, or still to be expended, on the three Saro flying-boats (the figures given waver between three and five million pounds), nor to discuss the likelihood of the prototype's completion by the beginning of 1950. A safe guess is that the power plant installation will not turn out to be the least tough problem confronting Saro and Bristol engineers, though the experience being gained in this connection with the "Brabazon I" might stand them in good stead. *Bi.*

Saunders-Roe SR/45 ten-engined long-range civil flying-boat.

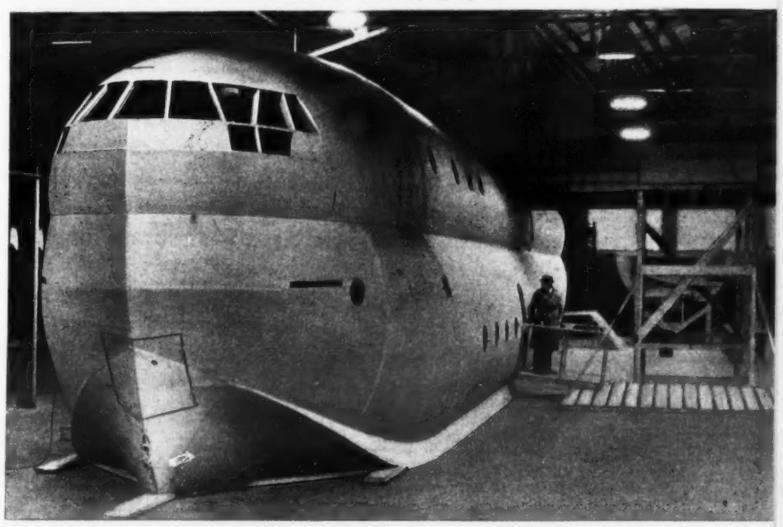


The SR/45's two decks will accommodate up to 100 passengers—comfortably since the entire hull section is to be pressurised and air-conditioned.



The figure-8 section of the SR/45's two-deck hull, with the intersection of the two circles forming the upper deck. This is the most efficient shape for pressurised hulls, both with regard to structural weight and accommodation of payload.

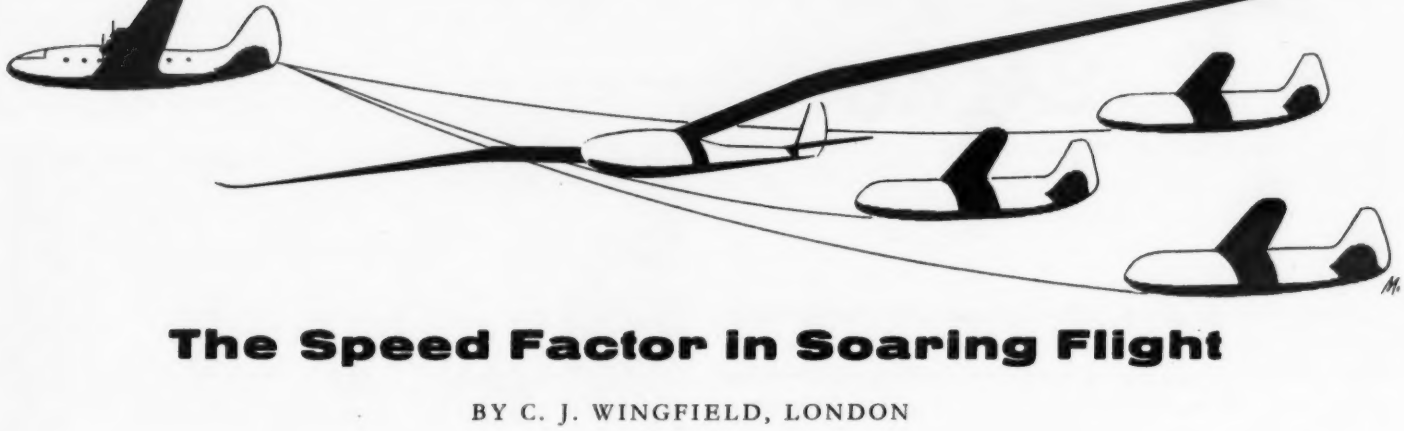
A full-scale mock-up of the hull has been built for studying layout.



The SR/45 under construction.

Gliding

Edited S/Ldr. Robert Kronfeld, London



The Speed Factor in Soaring Flight

BY C. J. WINGFIELD, LONDON

Holder of the British distance record (347.6 kms.) and out-and-return record (237 kms.) for gliders, the author received, in 1939, the 1,539th ISTUS award to glider-pilots, being the 53rd Britisher to achieve this honour. He was the 1946/47 Chairman of the Midland Gliding Club and is on the Council of the British Gliding Association. During the U.S. National Soaring Contests from July 3rd to 20th, 1947, Wingfield flew 54½ hours and 1,900 kilometres in gliders, was placed tenth, and won the second British Gold Badge.

It has been apparent for some years that, with the raising of national and international distance records above the 400-km. mark, any further increase will only be obtained by achieving *greater average speeds*; because in no part of the world will the time available for thermal flying be much in excess of eight or nine hours. Since my return from America, where I competed in the U. S. National Soaring Contests at Wichita Falls, Texas, I have been considering the subject and believe that the results achieved there are of sufficient interest to warrant their examination.

Mutual congratulations by gliding record holders: the author, C. J. Wingfield (right), shaking hands with the French record holder, Erich Nessler, during the U. S. National Soaring Contests of 1947.

Every long-distance flight in a sailplane consists essentially in the sequence of gaining altitude in a thermal up-current, gliding in the required direction until another up-current is found, where altitude is regained. Therefore, neglecting for the moment the effect of horizontal wind, one can generalise by saying that the average speed will be determined by the time taken to glide from the top of one thermal to the bottom of the next, plus the time taken to regain the lost altitude. Hence two variables: the flying speed of the sailplane during the glide, and the rate of climb in the thermal (during which time practically no progress towards one's goal is made). In the American contests I flew an "Olympia Eon," a medium-to-high performance sailplane with a maximum lift-to-drag ratio of 1:25 at 71—72 km./hr., and a minimum sinking speed of 70 cms./sec. at 62 km./hr. As the airspeed is increased above 72 km./hr., so the sinking speed increases and the L/D ratio becomes less, and the loss of height between thermals will be greater. But Wills has already shown that a higher average will be reached if the gliding speed is increased in proportion to the rate of climb, and calculated the following figures for the "Minimoa" sailplane, which has an almost identical performance graph with that of the "Olympia Eon." Where k = average rate of climb in thermal, v = airspeed of sailplane in the glide, and s = average groundspeed:

k (m./sec.)	v (km./hr.)	s (km./hr.)	
0.5	77	26.5	where wind speed = O and max. L/D = 1:25 at 72 km./hr.
1.0	83.5	43.5	
1.5	88.5	51.5	
2.0	93	58.0	
2.5	100	63	
3.0	106	67.5	

A further consideration is that the air in between thermals is rarely stable, sometimes descending at 3 to 4 m./sec., more usually at 1 to 2 m./sec. If the L/D of the sailplane is known for different airspeeds, it can again be shown that, for minimum loss of height, there is one optimum speed at which to fly through any given strength of down-current. Theoretically, speed should be altered to suit

U. S. version of the modern high-speed sailplane: the Ross "Ranger" (Wichita Falls, Texas). Designed for high speeds, it has its best gliding angle at about 80 km./hr.

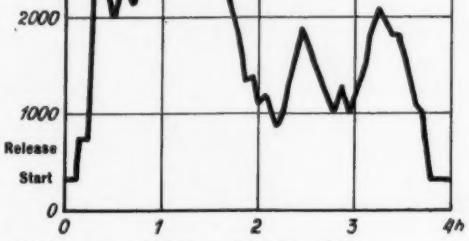
each different rate of descent encountered; but as this would mean continual variations, I believe that a compromise is best: moreover, the optimum airspeed to suit a given rate of climb is likely to be higher than that to suit down-currents on such a day. Both computations suffer from the disadvantage that the optimum speed depends on what the pilot expects to find during the course of the flight, and therefore can only hold good where thermals are of even strength and, more important, evenly distributed: obviously, if the pilot finds himself down to about 600 m. he must reduce speed to that for max. L/D. However, for the "Olympia Eon" one may summarise as follows:

for weak thermals up to 1 m./sec.:
optimum airspeed, 80 km./hr.

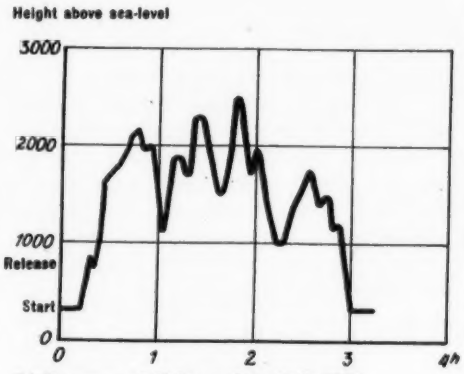
for medium thermals up to 2 m./sec.:
optimum airspeed, 95 km./hr.

for strong thermals up to 3 m./sec.:
optimum airspeed, 100-110 km./hr.

The next method to be discussed is not generally used: it will need boldness and may lead to premature landings. In general, immediately a pilot detects a thermal he will slow down and climb in it. But it takes a certain time for him to locate the thermal and accurately position himself so as to achieve the greatest rate of climb. Therefore, the fewer thermals he can use, the less will be the total loss of time in the whole flight. Perhaps this argument is impractical in the inferior conditions prevalent in England, where maximum heights often do not exceed 1,600 m. and the whole flight is likely to be an anxious time for the pilot: but given a ceiling of 2,000 m. or more, I am convinced that the pilot should refrain from using any thermal until he is down to 700 m. above ground. This argument presupposes that thermals are



(a) Barogram of flight on July 5th, 1947.



(b) Barogram of flight on July 17th, 1947.

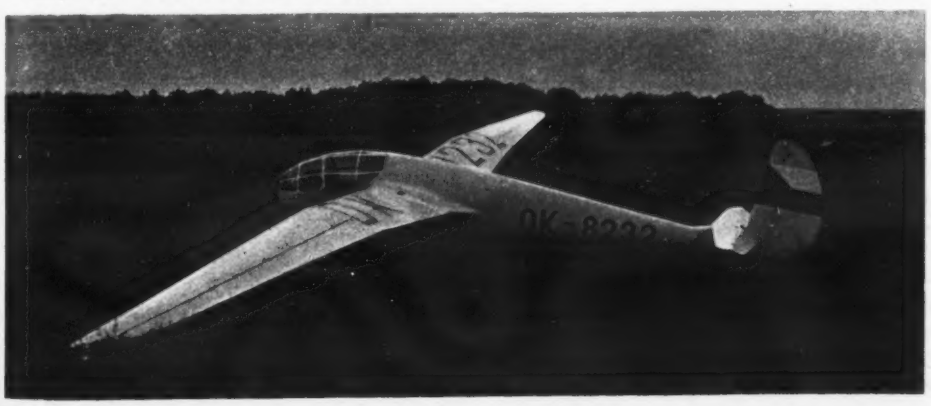
fairly strong, and frequently spaced. Hence it will not apply either early or late in the day, nor at any time when the pilot expects difficulties ahead.

The truth of this was demonstrated to me by two flights in America (see barograms). In the first, on July 5th, my turn for take-off was last, so that to make a reasonable distance I had to travel fast. The first 97 kms. were easy; using lift of 3 m./sec. under frequent cumulus, I climbed under each one. Then all cloud dissolved ahead, and the last 116 kms. were done on two big and one small thermals after a glide from 2,850 m. down to 550 m. above ground level, during which lift was no greater than 1 m./sec. Nevertheless, the average speed for each half of the flight was the same, 59 km./hr., although the wind remained the same, about 7—8 m./sec. from astern. Some days later, July 17th, on a poor day when thermals were infrequent, I averaged the fastest speed of the day, 58 km./hr. over 166 kms., with a wind astern of 9 m./sec. On this flight of 2 3/4 hours, only five thermals were used, with long glides from 2,300 down to 1,000 m. between. By contrast, on one of the best days I covered 340 kms. and, although the wind was astern, 5—7 m/sec., my average was no greater than 50 km./hr.; lift was strong and frequent, and I lost time in climbing in each thermal I met.

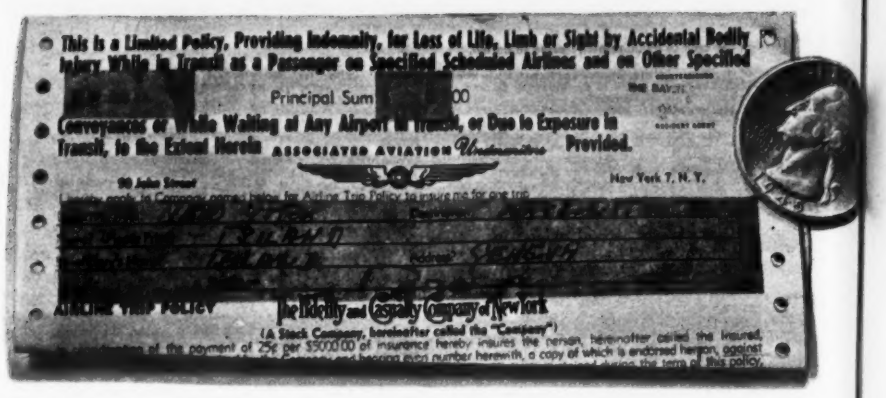
If the present distance records held by Russia are ever to be equalled, an average speed of 85-90 km./hr. will be necessary. In the American contests the two great aids to high speeds — strong winds, and cumulus arranged in long streets — were not forthcoming; the strength of up-currents was, however, greater than usually encountered, and several flights were prolonged by climbs to 3,000—4,000 m. in cumulo-nimbus late in the evening. A great variation of speeds occurred on each day. Possibly the finest flight was made by Nessler, who averaged 72 km./hr. over 512 kms., while others were doing 50 km./hr. over 320—350 kms. Robinson averaged 63½ km./hr. over 535 kms., whereas other speeds were below 50 km./hr. MacCready made a provisional world record "out-and-return" flight of about 370 kms. at 49½ km./hr., while I made a British out-and-return record of 237 kms. at 46 km./hr. The best other performance on this day was 55 km./hr. over 341 kms., which is surprising since one would expect a straight down-wind flight to be well in excess of the speed of an out-and-return flight.

In conclusion, pilots of championship class appear to know how to obtain the best possible results from the equipment at their disposal; so that improvements will either result from existing sailplanes in exceptional conditions, or from new designs. I believe that these will tend to increase the speed at which max. L/D occurs, rather than increase the L/D ratio itself, which has already reached values of 1 : 35 with exceptional designs. For example, the thermals of very large diameter in Texas would suit a sailplane which has its minimum sink at 80 km./hr. and max. L/D at around 100 km./hr., although such an aircraft might be quite useless in climates where thermal diameters were small. Since the preparation and execution of a flight of say 750 kms. will be a large undertaking, beyond the scope of the average glider pilot, such considerations will be of importance mainly to those interested in breaking the present records.

Example of a German high-speed sailplane: the "Rheinland," designed by the Flugtechnische Fachgruppe of the Technische Hochschule, Aachen, photographed in September, 1946, at Krapuly, gliding centre of the Czech National Aero Club. Span, 16 m.; wing loading, 20.5 kg./m²; gliding ratio, 1 : 28; rate of sink, 0.6 m./sec.; best L/D at 85 km./hr.; smallest rate of sink at 60 km./hr.



Must it Cost us Both Legs?


This is a Limited Policy, Providing Indemnity, for Loss of Life, Limb or Sight by Accidental Bodily Injury, While in Transit as a Passenger on Specified Scheduled Airlines and on Other Specified
Principal Sum
Conveyances or While Waiting at Any Airport in Transit, or Due to Exposure in Transit, to the Extent Herein
ASSOCIATED AVIATION Underwriters
Provided.
90 John Street
New York 7, N. Y.
The Fidelity and Casualty Company of New York
(A Stock Company, hereinafter called the "Company")

Snares in Aviation Accident Insurance

Insurers and insured have existed ever since the Romans founded their small co-operative funds for burials ; since the ancient Greeks conceived the idea of covering slave-owners against the escape of slaves ; since the time of Hammurabi, when caravan merchants agreed to share, mutually, the cost suffered by individual members from assault and robbery.

Accident insurance, which emerged from marine insurance, is very young ; and travel accident insurance, to which belongs aviation accident insurance, is its youngest branch. Whether old or young, however, the insurance company will be a friend of the insured as long as it pays ; his enemy when it refuses to pay.

The indemnity coverage of present-day aviation accident insurance policies is, in general, still somewhat limited, and is not always in just proportion to the premiums specified. It should be made clear from the beginning that this article does not concern the type of insurance which passengers acquire automatically on entering a commercial aeroplane—the liability of the airline companies and the underwriters behind them (cf. "Les problèmes des assurances aéronautiques" in Interavia, Vol I, No. 3.)—but the private insurance concluded by individuals for a given trip by air, which is valid alongside any other policy the insured may possess.

In his book on air law ("Traité de Droit Aérien," Recueil Sirey, Paris, 1947), Professor Maurice Lemoine devotes several chapters to the exclusions featured in French and other European aviation accident insurance policies. What he says about the policies for crew members applies equally well to passengers' policies :

> "The long list of exclusions is symbolic of the fear with which insurance companies undertake aviation risks. The formulation of the conditions is frequently ambiguous and is more often than not apt to lead to litigation, . . . the insurance protection offered seems to be uncertain here and there, and does not conform to the real requirements of the aviator (or airline passenger — Ed.)."

With the increasing safety factor in airline traffic, the confidence of insurance companies has all the same grown. Slowly but surely they have been showing themselves more willing to undertake aviation risks, even so far as to combine them in ordinary accident insurance policies. Of course, this applies primarily to trips on aircraft belonging to government-certificated companies, which are becoming far more exacting in the choice of their equipment and personnel, and thus offer a higher degree of safety. But the ordinary accident insurance policy, contrary to a life insurance policy, does not yet automatically cover airline accidents, and it will probably be some time before this becomes a matter of course. In the meantime ?

* * *

In the meantime the separate insurance concerns in Europe and the U. S. A. are developing a variegated sample of the most diverse types of policy. All aviation accident policies differ a little from each other, but the basic features of the majority are more or less consistent with the hitherto accepted scheme of accident insurance. And, without any exaggeration, it may be observed that the business methods and conditions suffer from a certain amount of "clumsiness."

In order to begin with a praiseworthy exception : The U. S. Associated Aviation Underwriters (Fidelity and Casualty Company of New York) have created, with their *Insurographs* (insurance slot machines have existed for years on the railways), an extremely simple and advantageous policy, offering conditions to which none of the usual European accident insurances can hold a candle.

Upon insertion of a 25-cent piece, the *Insurograph* delivers up a $5,000 insurance policy. The principal sum is paid out for loss of life or for total invalidity ; half of the principal sum for partial invalidity. Total invalidity signifies the loss of both hands or both feet, or the sight of both eyes, or else the loss of one hand and one foot, or either hand or foot and the sight of one eye. The loss of only one of the organs mentioned, constitutes partial invalidity. But wait a minute ! Other possible consequences of accidents are not heeded ; and loss shall mean, with regards to hands and feet, actual severance through or above the wrist or ankle joints.

But, look here, you might say ; such conditions are more than primitive and inadequate. After all, an accident can cause a multitude of other types of wound and permanent bodily injury. A certain airline passenger reading these conditions recently exclaimed, crudely but aptly, "This is fine, but how the . . . can you fix it so that you lose *both* legs ?"

Well, there is no doubt about it that this type of policy does not cover every conceivable injury ; but consider for a moment the amount of the principal sum in comparison with a 25-cent piece. Think of the expenditure involved in acquiring and maintaining the slot machines, taking into account the extraordinarily high rental fees in America ; and consider the administrative overhead costs which, despite the automats, are probably not much lower than those of any other U. S. or European insurance concern. At the Wall Street exchange rate, 5,000 dollars all the same amount to 1,240 pounds sterling, 590,000 French francs, 20,000 Swiss francs, or 18,000 Swedish crowns.

Then, again, the Americans do not grade their premiums according to mileage. Their policies are valid for trips within the *entire area composed of the Continent of the United States,* that portion of Canada which is within 150 miles of the international boundary, and the Territory of Hawaii. When a European wants to take out an aviation insurance policy, he first has to grab a pair of compasses and find out whether his destination is within 800, 1,000, 1,500 or more kilometres from his point of departure. As the distance grows, the premium increases.

Besides this, the European insurance companies do not issue policies for 25 cents a trip, but demand, according to mileage and insurance duration, ten to twenty times this sum. Then, again, the reader might be misled into delivering a cursory verdict : to the scrap heap with European insurance methods ; long live the U. S. policy ! But this judgment, despite many very obvious advantages of the *Insurograph* method, would be a little hasty.

* * *

What do European insurance companies give us for our money ? First of all, their policies are characterised by a more individual treatment of the possible consequences of accidents. As example, we give the list below of indemnities for partial invalidity, taken

from the conditions offered by the following companies: Northern Assurance Company, Ltd., London; Basler Lebensversicherung; Winterthurer Unfallversicherung; L'Assuratrice Italiana, Milan. (The conditions offered by other European concerns do not differ from these to any great extent.)

Indemnities for Partial Invalidity,

i. e. for loss of single limbs in percentage of the principal sum.

	right	left
One arm or one hand	60	50
One leg above the knee joint .	50	
One leg through or below the knee joint	45	
One foot	40	
One eye	30	
Thumb	22	18
Index finger	15	12
One of the other fingers . . .	8	6
Hearing of both ears . . .	60	
Hearing of one ear	15	

In contrast with the U. S. slot-machine policies, the Europeans indemnify the loss of single fingers and of hearing. But this is not all. The insurance conditions of most European companies likewise take into account further injuries, not expressly specified (internal injuries, concussion, etc.), and estimate the degree of invalidity according to the victim's ability to earn a livelihood. Conforming to the usual accident insurance scheme, and against payment of higher premiums, nearly all European aviation accident insurers pay out daily indemnities for loss of income, and also bear the costs of medical treatment up to sums not exceeding 1,000 to 3,000 Swiss francs ($250 to $750).

Logically enough, the European premiums must be higher, since companies like the Fidelity and Casualty Company of New York are not only spared the costs of daily indemnities and medical treatment, but they also reduce their expenses to a minimum as regards *establishing the consequences of accidents.* The loss of a hand, foot or eye is fairly easy to establish, but the diagnosis of internal bodily injuries entails considerably greater expenditure.

If we wished to calculate the premium which would have to be paid for a European policy drawn up along the same conditions as those offered by U. S. insurers, we would have to start off with a trip of about 2,000 miles. Remember that the *Insurograph* policy is valid for the entire U. S. A. and the premium is not graded according to mileage. We would therefore have to compare one of the longest air trips possible within the continental U. S. —New York to San Francisco, for instance, which amounts to 1,905 miles—with a corresponding European route. The London—Athens route is 1,690 miles long. Based on a principal sum of $5,000, or Sw. frs. 20,000, the average European accident insurance premium for one trip over this distance would have to be calculated as follows:

Indemnity	*Premium*
Loss of life (Sw. frs. 20,000 = $5,000)	. . . frs. 7.— ($1.75)
Invalidity (Sw. frs. 20,000 = $5,000)	. . . frs. 3.— ($0.75)
Plus policy cost and tax	. . . frs. 1.10 ($0.28)
	Sw. frs. 11.10 ($2.78)

The sum of Sw. frs. 11.10 ($2.78) would have to be doubled, since the European policy does not cover round trips, but only one-way flights. Consequently, in Europe one would have to pay Sw. frs. 22.20 ($5.55) for the same indemnity, i. e., 22 times as much as in the U. S. A.

If, however, one wishes to receive a daily indemnity of Sw. frs. 20.— ($5) and convalesence expenses amounting to Sw. frs. 2,000 ($500), then the basic tariff for invalidity would have to be doubled. Because the daily indemnity may only amount to 1/3rd per cent. of the principal sum for invalidity, one would have to be insured for frs. 40,000 ($10,000) against invalidity. Thus we would have to add to the above calculation: Sw. frs. 3.— ($0.75) for invalidity and Sw. frs. 3.— ($0.75) for a daily indemnity of frs. 20.— ($5) during one year. Then this sum, too, would have to be doubled, so that for a 2,000-mile round trip, a total of Sw. frs. 34.20 ($8.55) would have to be paid.

For the sake of justice, it should be mentioned that policies for short trips not exceeding 500 miles only cost one seventh of this sum.

* * *

Well and good, the European premiums seem to be very much more expensive and the policy conditions and business methods far more clumsy than in the U. S. A.—but what about the "ambiguous conditions," the "uncertain protection," and the "snares" mentioned at the beginning of this article? Well, there is no dearth in this respect. You only need to make a random selection of a few of the exclusions featured in almost any insurance policy. When it states:

> "Also covered are accidents which take place during temporary stop-overs on airfields for intermediate landings . . . If the trip is interrupted, the insurance is invalidated from the moment of deplaning . . . until the moment of enplaning,"

then there is another field for litigation: one only needs to think of night halts, either scheduled or else due to exceptional circumstances. Does the policy cover accidents which might occur during a stay in an airport hotel or any other hotel indicated by the airline company?

Even in the case of a seemingly harmless policy condition such as:

> "The insurance commences in the moment when the insured enplanes, and expires in the moment the insured deplanes . . ."

one can become entangled. Let us assume that the passenger was just about to enter the specified aeroplane and this, or any other aircraft, taxied into him and injured him. Would he have any claim to damages? The above condition rather points to the contrary. But would not a limitation of this sort be extremely unfair?

Both the conditions mentioned above are taken from European insurance policies. However, in case any one should think that insurance court cases are unknown in the U. S. A., here is a passage taken from a list of exclusions in a U. S. policy:

> "This insurance shall not cover death, dismemberment or loss of sight caused wholly or partly by bodily or mental infirmity, or by bacterial infections (except pyogenic infections which shall occur through an accidental cut or wound and any infection resulting directly from exposure due to a forced landing), or by any other kind of disease (except any disease resulting directly from exposure due to a forced landing), or by suicide or any attempt thereat (sane or insane) . . ."

Read in English, Spanish, French, or any other language of the world, this sentence can hardly be termed as one of Euclidian clarity. One is loth to congratulate the author thereof, and it is with a shudder that one thinks of how the insurance company and the victim's heirs would tackle this syntactical monster if they came to a juridical hand-to-hand fight.

Rather doubtful seems to be the condition relative to suicide or any attempt thereat (sane or insane). It would be altogether unreasonable to exclude a victim from award of the principal sum if he were driven by deathly fear to temporary insanity and then to attempted suicide.

It is useless to seek refuge in the fact that these examples are not characteristic only of aviation accident insurance, but that similar formulations have existed for ages in the conditions relative to any accident insurance policy one might wish to choose. This does not make things any better, but on the contrary, tends to make them worse. An aviation accident insurance policy must contain especially clear and unambiguous conditions; otherwise it has no *raison d'être.*

The International Air Transport Association is centralising its huge administrative apparatus by confining its activities to three instead of nine Regional Traffic Conferences, and plans to introduce a universal standard air ticket. The International Civil Aviation Organisation is struggling to cut down red tape. Thus world aviation is streamlining its organisation. We would like to put the question to the European aviation insurers of whether they would not agree to eliminate grading according to mileage and to reduce the present cost of premiums, this in order that it may be worth our while to continue taking out European aviation accident policies. *He.*

Black and White

M'banga is the largest of a small group of villages situated on a certain wooded ridge on the Gold Coast. It is where the District Commissioner lives. The Residency is sumptuous in contrast to the straggling native huts outside the grounds, but there seems to be no means of preventing the jungle odours from invading it.

The Commissioner set down his whisky on the small bamboo table. He did not like his visitors. The thickset, bespectacled man who liked to be called 'Colonel' was too suave, too crafty. His companion, tall, lean, his lips compressed to a thin line, had the hard stare of a gambler ; he was too sure of himself. Both were in immaculate white ducks, and their sun helmets bore no honest stain of perspiration.

"There could be something in what you say," the Commissioner said, bending forward uncomfortably to knock his pipe against the edge of the veranda floor and simultaneously to think of something to say. "There's no denying that you could bridge plenty of the jungle's unpleasantness with your aeroplane. I'm not a flying man myself, but I dare say there's something in skimming at a hundred miles an hour over awkward rivers and swamps—and awkward animals and people, too."

This brought forth a perfunctory titter from the 'Colonel.' The lean man continued to stare stonily at his spotless, white shoes. Obviously, he thought, after thirty years in the Colonies, the Commissioner's brain had been addled by the tropical sun.

"But I don't want to discourage you, you know." The Commissioner's hesitancy had mysteriously gone. There was a gleam in his eye. Those who knew him would have read it as a mischievous gleam. "As a matter of fact, I think the thing could be arranged all right." His wicker chair creaked as he leaned forward. He evidently had an idea at the back of his head. "Yes, after all, you seem to know your way about the jungle. You know a lot about my people, too. What you said about the influence of . . . er . . . Islam art on Negro art is very interesting . . . very interesting indeed. Of course, I'd advise you not to overrate my people, however artistic you may judge them to be. They are really children, you know ; and quite naughty children too. If your hat blows off or you fall out of a tree, you'll please the people of M'banga far more than if you presented them with the original Venus of Milo.

"As far as I can judge, a childish, likeable people," the 'Colonel' said, nodding smugly as he and his companion rose to bid the Commissioner farewell.

"Well, that depends," replied the Commissioner, almost grinning his head off, for some unknown reason.

* * *

The next evening the Commissioner's lieutenant held palaver with a delegation of the Dualas, a highly intelligent tribe living about a hundred and fifty miles across the jungle from M'banga. The Duala warriors stood in a deep circle in the forest clearing and, after a good number of salaams had been exchanged, the young lieutenant began.

" It is the high word of the Commissioner I read to you . . . They will come tomorrow, the two white men in their aeroplane."

The warriors were grinning in anticipation, for they had seen many aeroplanes and no longer feared them.

"Remember, they have the special protection of the Commissioner. Be friendly and polite . . . no ju-ju, no accepting the 'water that burns.' Now if I get any complaints—*watu s'latu waan'gua* : it'll be a poor look out for you."

* * *

The cream paintwork of an all-wood, two-seater monoplane gleamed in the morning sun. Its propeller raised flurries of dust from the 'air strip' behind the Residency. The 'Colonel' was already in the passenger seat and the lean man was checking the undercarriage prior to climbing aboard.

The Commissioner ambled out of the grounds towards the aeroplane.

"Incidentally, did I ever tell you the story of the 'Mary Ann,' the old Naval training ship that came here in '32 ?"

By way of retort, the 'Colonel' looked meaningly at his wrist-watch. Courtesy toward the Commissioner compelled him to clamber out of his seat to say a perfunctory goodbye. Realising that he wasn't the least bit interested in the 'Mary Ann,' the Commissioner didn't bother to continue.

Less than two hours later the pilot gunned the engine and flattened out to make a perfect three-point landing in a spacious jungle clearing. He taxied along to a shady spot, skilfully manoeuvring his machine in between the numerous termite nests, six-foot high mounds, covered with coarse grass and thorns. The air was hot and steamy, smelling of stagnant water and putrefaction.

The bush 'telegraph' system is efficient. No sooner had the 'explorers' alighted than the natives came swarming around the plane. Long, short, fat and thin, all the Dualas were there, chattering and giggling in unison with the squealing of the monkeys which, their curiosity having by now got the better of their fears, had come along in thousands to view the antics of their decadent descendants.

The 'Colonel' raised his arms in a fatherly gesture and beamed unctuously at the natives. His knowledge of the Bantu tongue was astonishingly good. He spoke persuasively and the atrocious clamour died down. He had brought many beautiful gifts. For his part, he hoped for a gift too. His thoughts were on the '*kiti kiz'ri*'—the 'beautiful chair'—which, to tell the truth, constituted the sole interest of his 'cultural' expedition into the jungle.

Meanwhile, the 'beautiful chair' was in its usual, none-too-beautiful surroundings. The Duala chief's hut was higher than the others, and more uglified by the use of rusty bits of flattened oil drums. In fact, its main distinguishing feature was that it was the most prominent eyesore in the village. But the 'Colonel' didn't seem to notice the filth, and not even the smells. His small, greedy eyes were glued to the chair—in reality a kind of stool, but of solid ivory, intricately carved—a perfect specimen of Islam and Negro art—a collector's gem.

Unfortunately, the Dualas also knew its value—in sterling, too. Bargaining was uphill. At first the chief was adamant. To the 'Colonel's' disappointment, not for all the beads in Woolworth's would he part with the chair.

There was never any unanimous agreement as to whether the 'Colonel's' natural charm worked the trick, or if it was his Colt .32 that finally clinched the bargain, but, at all events, the chair was safely packed away in the aeroplane by sundown. And it was not the only freight on board. A lot of other nice little ivory carvings had also found their way there. In fact, Christie's could have issued quite a neat little catalogue—"Rare African Art, private collection of Colonel . . ."

And so mused the 'Colonel' as he lay in the hard bunk of the corrugated-iron hut which the District Commissioner's men used as temporary quarters when on their rounds of inspection. The sudden nightfall in the jungle had compelled them to wait until morning before leaving. As a soporific measure, the 'Colonel' found it infinitely more soothing to count pounds than sheep . . . £3,500, £4,000, £5,000 . . .

In the meantime, however, the tribesmen had their doubts. Many were not fully satisfied with the way in which their chief had acted

But the chief was apparently a wise man, and his palaver with them ended happily. Indeed, one did not need to know Bantu to understand this. From the frequent use of the word 'guinea' it was clear that the chief had something up his sleeve. The men, women, children, and even the animals, returned peacefully to their huts—which were perhaps not so richly decorated as they had been that morning.

* * *

The sun had hardly reddened the horizon when the 'Colonel,' a little stiff in the joints, was crossing the clearing towards the aeroplane. With a grunt of relief he swung his leg up to climb in . . .

The rending crash which ensued echoed through the jungle clearing for at least ten seconds. Dazed, but otherwise unhurt, the 'Colonel' picked himself up from the thorny ground.

In a cloud of dust stood the outline of what, only the day before, had been a smart two-seater sports plane. Virtually nothing was left but the engine, the undercarriage and the dashboard. The rest—except for the ivory chair and carvings—had gone the way of everything mortal—to dust.

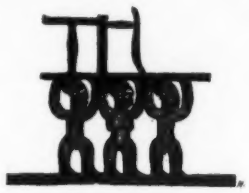
But a laugh was audible through the dust cloud—a laugh which to the 'Colonel' and his companion seemed neither childish nor likeable.

Then fresh negotiations began. They went on until the tribesmen had calmed down sufficiently to agree — at an exorbitant price — to accompany the intrepid explorers on a week's trek through the jungle.

* * *

The Commissioner had to make an effort to conceal his satisfaction as the two sorely-bedraggled explorers limped up the veranda steps. "Well, well, this is unfortunate," he said, tut-tutting sympathetically, and reaching over for the whisky decanter. "It's such a shame, too, but I really wanted to warn you just before you left. But, you see, you were in such a hurry that I hadn't time to tell you about the 'Mary Ann.' Nobody around these parts will ever forget the tale. She was a fair-sized ship, entirely of wood, and her captain had moored her at the river bank about a mile from here. In one night she was devoured by termites."

The 'Colonel's' subsequent remarks were quite unprintable. In fact, his general behaviour until the boat left two days later was hardly that which you would have expected from a distinguished officer in His Majesty's service.



Book Reviews

Das Fliegerbuch. Edited by Ernst Wetter. Published by the Büchergilde Gutenberg, Zurich, 1947.

Those who wish to acquaint the layman with the technical or commercial problems of aeronautics run two dangers. Either they present them too simply and produce a book for youths, which has nothing to offer the adult reader, or the technical explanations become too complicated, so that the reader becomes bored and puts the book down. In this book Ernst Wetter, a flying instructor, has managed to avoid both pitfalls in an exemplary manner. A careful choice of collaborators, six in all, has led to a compact presentation of the fundamental principles of aeronautical engineering, civil air transport, service aviation, gliding and model flying.

This book is not likely to become obsolete as quickly as many similar works have done. For, although it gives an impartial and complete picture of contemporary aeronautics, it is in no way bound to the ephemeral. Indeed, it penetrates to fundamental problems common to each field of the subject.

As usual the Büchergilde Gutenberg has produced a volume of handsome appearance. It would be a good thing if it could be translated into other languages, for this general review is no more of a local character than flying itself. One would wish it to be distributed as widely as possible. (German). *He*

The Aircraft Year Book, 1947 : 29th Edition. Edited by Howard Mingos. Lancier Publishers, Inc., New York.

The 29th edition of this, the best-known U.S. year book on the aeronautical industries, originally published by the Aeronautical Chamber of Commerce of America, Inc., has appeared. Every year Howard Mingos compiles a survey of the activity of the entire U.S. aeronautical industry, of the Air Force, civil aviation, private flying, and kindred subjects. Reliable descriptions from *official* sources (and this is what makes the book particularly valuable) of aircraft, aero engines and accessories, in construction or under test, are compressed into fewer than 500 pages. In it may also be found everything worth knowing about the Air Force and the Naval Air Force as well as the activity of aeronautical authorities. Statistics covering these fields, together with a list of all the leading men in the official aeronautical organisations, form a particularly interesting appendix to the book. Although the comprehensive material is not presented with especial clarity, the Aircraft Year Book in its 1947 edition is a trustworthy book of reference which will repay study. (English.) *Bi.*

Trajectoires. By Emile V. Witmeur. Published by Soledi, Liège.

If you want to recapture a whiff of the romantic freedom which we used to connect with flying you must go to colonial airmen on their aircraft carriers. In *Trajectoires,* a colourful, racy piece of entertainment without literary pretensions, the author tells how air instructors and their pupils live and die on board a British aircraft carrier off the North African coast—before the war, fortunately. Airmen, women, dogs, cats, sandstorms, telegrams—here are all the ingredients of a pleasant book to while away a dull hour. (French.) *He.*

Les Armes secrètes allemandes. By Albert Ducrocq. Published by Editions Berger-Lerault, Paris, 1947.

Could Germany have won the War with the help of the secret weapons she was still developing, if the Allies had allowed her two or three months' time ? The author answers this question with an unqualified affirmative and hopes to frighten humanity off the next war by giving a comprehensive description of the Germans' war machinery. Unfortunately he allows himself to be swept away by this wish so much that he tells fairy stories. He relates quite seriously that on 27th April, 1945, the Germans had four hundred Heinkel bombers, with a range of six to seven thousand miles, ready to bomb the U.S.A. This makes one doubt the reliability of his sources. Ducrocq has also produced a long and, on his own admission, incomplete account of the last German U-boats, has thoroughly discussed the V1 and V2, together with flak and aerial projectiles, ending up with the atom bomb and artificial satellites. Readers who are not particularly interested in technical accuracy will find excitement and entertainment in this book. (French.) *Bi.*

Aviation Accident Law. By Charles S. Rhyne. Published by Columbia Law Book Company, Washington, 1947.

The growth of civil aviation in the U.S.A., the number of miles flown with passengers, freight or mail, the number of certificates issued for transport and private planes—all these figures are ten or a hundred times those which other countries can show. American officials estimate that in five years the U.S.A. will have a total of at least 300,000 aircraft. At first sight, therefore, it is surprising that the United States have hitherto had no comprehensive legislation on air accidents. There is really no ground for astonishment, however. American lawyers and officials, conservative in the best sense of the word, incline to the English and Roman legal conceptions. They prefer an organic development of case law based on court decisions to hastily constructed enactments which are out of date as soon as they are promulgated. They are content with a framework of statute law (Civil Aeronautics Act of 1938, Federal Airport Act of 1946) and leave the rest to the American bench and to the litigants.

This makes a survey of all the court decisions with regard to aviation all the more necessary. The author, who is Chairman of the American Bar Association's Committee on Aeronautical Law, provides this in an exemplary manner. Despite the fact that it forms a complete collection of all the relevant court decisions, the book is not merely a monotonous list of cases, but a systematic textbook, arranged according to the different subjects involved. It deals with the development of International Law as carefully as with United States law. The Warsaw Agreement and European writings play a by no means unimportant part. For this very reason Aviation Accident Law can be warmly recommended to lawyers in every country. (English.) *He.*

Official Bulletin of the F.A.I.

FÉDÉRATION AÉRONAUTIQUE INTERNATIONALE, PARIS

The Meeting of the *Conseil Général* of the Fédération Aéronautique Internationale, which should have taken place in Paris on December 8th and 9th, 1947, had to be postponed to January 5th and 6th, 1948. An account of the Meeting will be given in our next issue.

WORLD RECORDS

Distance in a Closed Circuit (U.S.A.)

Lt.-Col. O. F. Lassiter and Captain W. J. Valentino, pilots; crew of eight (U.S.A.A.F.); 1st-3rd August, 1947 . . . . . 14,249.656 kms.

Speed over a Measured Course (U.S.A.)

Cmdr. Turner F. Caldwell, Jr., 20th August, 1947 1,031.178 km./hr.
Major Marion E. Carl, U.S. Marine Corps, 25th August, 1947 . . . . . 1,047.536 km./hr.

INTERNATIONAL RECORDS

Class C

Distance in a Closed Circuit (U.S.A.)

Lt.-Col O. F. Lassiter and Captain W. J. Valentino, pilots; crew of eight; Boeing B-29 monoplane, 4 Wright R-3350-57A 2,200-H.P. engines. McDill Field, Tampa, Florida, 1st-3rd August, 1947. . . . . 14,249.656 kms.

Speed over a 3-km. Course (U.S.A.)

Cdr. Turner F. Caldwell, Jr., U.S. Navy; Douglas D-558 "Skystreak" monoplane, TG-180 jet engine, 1.814,376 kgs. thrust. Muroc Dry Lake, Calif., 20th August, 1947. . . . . 1,031.178 km./hr.
Major Marion E. Carl, U.S. Marine Corps; Douglas D-558 "Skystreak" monoplane, TG-180 jet engine, 1,814.376 kgs. thrust. Muroc Dry Lake, Calif., 25th August, 1947 . . . . . 1,047.536 km./hr.

Speed over 100 kms. (Great Britain)

Group Captain John Cunningham, D.S.O., D.F.C.; de Havilland "Vampire I" monoplane, de Haviland "Goblin" jet engine. Lympne Airport, Kent, 31st August, 1947 . . . . . 799.644 km./hr.

Speed over 10,000 kms. (U.S.A.)

Lt.-Col. O. F. Lassiter and Capt. J. W. Valentino, pilots; crew of eight; Boeing B-29 monoplane, 4 Wright 2,200-H. P. engines. Wright Field, Dayton, Ohio, 29th-30th July, 1947. 439.665 km./hr.

Section d'Aviation Privée de la F.A.I.

In accordance with a decision taken at the 1947 General Conference in Geneva, a Private Flying Section of the F.A.I. has been set up. Headquarters are to be at the Royal Aero Club, Londonderry House, Park Lane, London.

Management.

The Private Flying Section is under the jurisdiction of the F.A.I. Office in Paris. In order to help the F.A.I. to re-activate its post-war activities, the Royal Aero Club is paying the Section's expenses until appropriate arrangements have been completed with the F.A.I. Office in Paris.

Services. Bureau de Renseignements.

An Information Office grants information free of charge to all national aero clubs on the F.A.I. roster.

Bureau de Tourisme Aérien.

Latest information on routes, landing facilities, supplies and all questions connected with air touring can be obtained from the Section's Air Touring Office. In addition, the office's experience and services are available to affiliated national aero clubs planning to set up air touring offices of their own.

Bureau de Cartes Géographiques Aériennes.

The Air Map Office's large stock of maps of all parts of the world are available upon demand by member clubs.

Les Guides de Tourisme Aérien de la F.A.I.

Air Tourist Guides shall be compiled from time to time in collaboration with member aero clubs.

Liaison.

The title of Honorary Member of the Royal Aero Club will be extended to all executive officials of national aero clubs visiting the F.A.I.'s Private Aviation Section in London. Such Honorary Members will have the R. Ae. C.'s residential facilities at their disposal.

Representatives of the Private Aviation Section will willingly visit national aero clubs, by arrangement, to discuss any important problems.

F.A.I. Information Bulletin. (Private Flying Section)

Two copies of the Information Bulletin of the Private Aviation Section will be sent free of charge to each national aero club affiliated to the F.A.I. Upon demand, extra copies will be supplied to national aero clubs wishing to distribute them to individual subscribers in their respective countries. Bulletins will be sent by air direct to member aero clubs. Subscription rates, including airmail charges, amount to £1. a year for Europe and £1.10.0 a year for all other parts of the world. Individual subscribers should make necessary arrangements with their national aero clubs and not direct with London.

The Information Bulletin will contain news items collected by the Information Office of the Private Flying Section and will aim to provide aero clubs with useful information and advice on private flying throughout the world.

It will only be possible to distribute the Information Bulletin privately. It will not be on sale to the public, since the copyrights of aviation journals must be respected.

It will appear as soon as the necessary contacts have been made with national aero clubs for assuring a regular despatch of suitable information.

The principal source of information for the Bulletin should be the national aero clubs themselves. News and general information should be edited in English or in French. However, in cases where this should not be possible, texts edited in other languages will be accepted.

To begin with the Bulletin will appear monthly and will be published in French and English, the two official languages of the F.A.I.

If the demand for the Bulletin justifies the additional expense of its translation into other languages by the F.A.I.'s Private Flying Section, an estimate of the cost of this work will be submitted to the national aero clubs interested. Meanwhile, in view of the present circumstances, it would seem more practical for them to have the Bulletins translated in their own countries.

National aero clubs shall appoint a representative with whom the Editor of the Information Bulletin can keep in regular touch.

THE MONTH IN REVIEW

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AIR POLITICS

● Returning from his air journey to the Near East, Dr. Ivan Pietor, the *Czechoslovak* Minister of Communications, stated that bilateral civil aviation agreements would be concluded with *Greece, Egypt, Palestine* and *Turkey* in the spring.

● The Government of *Pakistan* has accepted the terms of the civil aviation agreements concluded with the *United States, France* and *Holland* by the pre-partition Indian Government.

● It is expected in Rome that negotiations for bilateral civil aviation agreements with *India* and *Pakistan* will soon be started by the *Italian* Government.

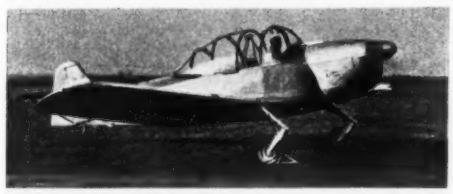
● *Civil aviation agreements* have been concluded between : Denmark and Portugal ; Great Britain and Peru, in Lima on December 22nd ; Italy and Holland, in Rome.

● It is expected that the negotiations which have been going on between Scandinavian Airlines System and the South African authorities since May, 1947, concerning the pool operation of services by SAS and a South African company, will shortly reach a satisfactory conclusion. SAS desires to open a regular service to South Africa in the spring.

NEW AIRCRAFT

First Flights :

● The prototype of the *Fokker-Diepen S.11 "Instructor"* two- or three-seater trainer took to the air on December 18th, 1947. Other aircraft that made their first flights before the end of 1947 were the : *Fairey "Gyrodyne"* single-engined helicopter, piloted by Squadron Leader B. H. Arkell ; and the *Chase XCG-18A "Avitruc,"* a cargo glider developed by Chase Aircraft Co., Inc., for the USAF, which is an all-metal, high-wing monoplane suitable for transporting cargo



Fokker-Diepen S. 11 "Instructor."

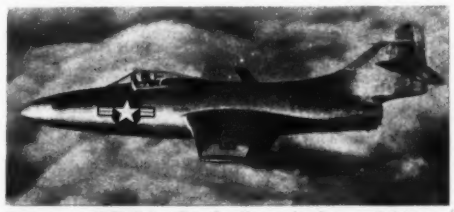
or alternatively 30 fully-equipped soldiers. The "Avitruc's" span is 86 ft., length 53 ft., gross weight 15,000 lbs. with a payload of 8,000 lbs. In Italy, the flight test programme of the *SIAI-Marchetti SM-101* light transport and personal aircraft has started.

SIAI-Marchetti SM. 101.

* Excerpts from Nos. 1397-1410 (9th December, 1947, to 10th January, 1948) of "Interavia, International Correspondence on Aviation," an illustrated newsletter published thrice weekly in four languages—English, French, Spanish and German.

● *SNCA du Centre* has started on the prototype of a new twin-engined jet-propelled bomber, to be known as the *NC 270*. Its actual construction was preceded by comprehensive preliminary work : besides a complete mock-up of the aircraft, a flying test model, the NC 271, was also built. It is hoped to complete a prototype during the course of 1948. Mainplane and tail surfaces of the NC 270 have sweepback. The fuselage, which has a pointed nose, contains a crew compartment for two, behind which are located fuel tanks for the Rolls-Royce "Nene" turbo-jet (built under licence by Société Française Hispano Suiza). Maximum speed is to be 602 m.p.h. and range, 2,240 miles.

● *Grumman XF9F-2 "Panther"* is the designation of a new carrier-borne fighter developed for the U.S. Navy. Of the three prototypes to be built, the first will have a British-manufactured Rolls-Royce "Nene," the second a "Nene" built under licence by Pratt & Whitney and the third an Allison turbo-jet of the J-33 series. About one half of the production "Panthers" will be powered by "Nenes," built by P & W under the designation of J-42 and developing a static thrust of 5,000 lbs., or 5,750 lbs. with water-injection. The other half of the production aircraft will have Allison J-33's, developing 4,600 lbs. static thrust for take-off, or 5,000 lbs. with water-injection. The prototype of the "Panther" with the British-manufactured "Nene" is already undergoing flight-tests, the start of the test-flight programme of the other two prototypes depending on the availability of J-42 and J-33 engines. An initial prototype of the J-42, designated J-42-P-42, should be available for operational testing in March and line production should start in October. So far no datum on characteristics and performance of the "Panther" has been released ; it is merely stated that the aeroplane should be capable of attaining speeds of over 600 m.p.h.



Grumman XF9F-2 "Panther" carrier-borne fighter.

● United Helicopters, Inc., which is headed by Stanley Hiller, Jr., has completed the prototype of the *"Hiller 360"* helicopter. It has a single two-blade main rotor and a co-axial anti-torque rotor in the same plane of rotation ; an all-metal, semi-monocoque cabin-fuselage merges into a tubular member for supporting the anti-torque rotor. The aircraft is at present undergoing its CAA type certification tests and should go into production in the spring.

Prototype of the "Hiller 360."

● The Civil Aeronautics Administration has certificated the *Bell Model 47D* helicopter. Like other models in the Model 47 series, the 47D can be used for a wide variety of purposes : mail services, agricultural crop dusting, amphibious operation (with the addition of flotation gear), and can also be equipped for night flying. It differs from earlier models of its series in having a convertible bubble-canopy arrangement permitting flight with either open or closed cockpit.

Bell Model 47D with side-walls and canopy removed.

● The USAF has awarded *Fairchild Engine and Airplane Corp.* a contract valued at $20,000,000 for the supply of 37 *Fairchild C-119* freight transports. The new model is basically a development of the Fairchild C-82 "Packet," with wider fuselage, greater freight capacity and a considerably increased take-off weight. Power plant comprises two Pratt & Wihtney R-4360 "Wasp Major" air-cooled 28-cylinder four-row radials developing 3,250 H.P. for take-off and rated at 2,650 H.P. Take-off weight is 74,000 lbs., landing weight 50,000 lbs. ; payload is 9 tons at a range of 2,000 miles, and maximum payload is 10 tons with correspondingly-diminished range.

POWER PLANTS

● New versions of both the *Continental G-85* air-cooled flat-four of 85 H.P. and the *Continental C-125* air-cooled flat-six of 124 H.P. have been developed. The first, of which the designation is not yet known, delivers 90 H.P. ; the second, designated C-145, delivers 145 H.P.

● *Wright XT-35* is the designation of a new airscrew-turbine developed by Wright Aeronautical Corp. Expected to have a shaft power of 7,500 H.P., its operational testing is being carried out in the nose of a Boeing B-17 "Flying Fortress."

INDUSTRIAL NEWS

● *Boeing Aircraft Co.* has been awarded a contract valued at almost $60,000,000 for another 82 *Boeing B-50* four-engined bombers. The total number of these aircraft ordered is now brought to 215.

● *Hindustan Aircraft Co., Ltd.,* of Bangalore, the Indian state-owned aircraft manufacturing concern, has started building *Percival "Prentice"* trainers under licence. The first aircraft should be completed by May.

John K. Northrop, President of Northrop Aircraft, Inc., has been elected *President of the Institute of the Aeronautical Sciences for the 1948 period.*

● *Caproni Macchi Sociedad Anonima Argentina de Aviacion* is the name of a new, purely-private, Italian aircraft manufacturing firm in Argentina, which is to build aircraft, aero engines and aircraft accessories. The company will shortly start erecting manufacturing facilities and will import tooling equipment from Italy. Several hundred Italian emigrants are to be employed.

● On December 15th, *The Glenn L. Martin Co.* announced that it had abandoned work on its *Martin 3-0-3* project, pressurised cabin version of the Martin *2-0-2*. According to Glenn L. Martin, the company's President, dropping the 3-0-3 will enable "further concentration" to be applied to the 2-0-2, as well as to military contracts, both awarded and expected.

INTERNATIONAL ORGANISATIONS

● ICAO : The main lines of the *Regional Organisation* of ICAO have now been laid down. There will be *five* branch offices instead of the ten originally planned. ICAO Headquarters in *Montreal* will also serve as the North American branch office, *Paris* for Europe, *Cairo* for the Middle East and (provisionally) *Melbourne* for the Far East.

AIR TRANSPORTATION

● INTERCONTINENTAL : *KLM Royal Dutch Airlines* plans to open a regular service from *Amsterdam to Shanghai*, via Bangkok and Canton, in April ; and also to extend its service to Batavia once weekly to *Sydney*, and to introduce Lockheed "Constellations" with sleeping berths on to one of the weekly flights to Batavia.

● *Air France* plans to intensify its service from *Paris to Saigon* from one to two round flights weekly as from January 12th, and to provide a fortnightly connection to Shanghai. During January, Air France will add a fifth weekly flight to the *Paris—New York* service, and is planning a *Paris—Berlin* service.

● KLM is now operating its *Amsterdam—Johannesburg* service with Lockheed "Constellations," of which it now possesses seventeen. By using these aircraft instead of Douglas DC-4's, the time for the trip is cut from 48 to 30 hours.

● *Air-India International, Ltd.*, which is half-owned by the Indian Government, will open its service to *London* in June. Unconfirmed French and American reports state that the company has ordered three Lockheed L-749 "Constellations," which would make the Bombay—London trip in 22 hours. Mr. J. R. D. Tata is head of Air-India International.

● *Iberia*, the Spanish airline, has taken over the transport of Argentine airmail for Europe, following the ratification of the Argentine-Spanish civil aviation agreement. The provisions of the agreement give the Spanish airline exemption from Argentine taxes on aviation fuel.

● EUROPE : Italian Government circles are stated to be in favour of fostering the Government-owned overseas airline, *Linee Aeree Transcontinentali Italiane (LATI)*, and giving it special route assignments (probably abroad). This would be different from the fate accorded to the Government-owned Ala Italiana, which is now in liquidation If LATI resumes its activity, this will not affect other Italian operators on routes assigned to them. Thus the Anglo-Italian Alitalia would probably retain its rights to take over LATI's former concessions granted at its formation by agreement with the Italian Government. Amedeo Paradisi, still President of LATI, is one of the outstanding Italian authorities on the development of long-range services.

● The Soviet-Hungarian *Mazlovet* is operating three international services weekly from *Budapest to Prague* (in pool with the Czechoslavakian CSA), two of which have intermediate landings at Bratislava ; a weekly *Budapest-Warsaw* service (in pool with the Polish LOT) which continues from Budapest to *Belgrade ;* a *Budapest—Belgrade* service (in pool with the Soviet-Yugoslav JUSTA) and a *Budapest—Bucharest* route in pool with the Soviet-Rumanian TARS.

● Since it took over KNILM (Royal Netherlands East Indies Airways), KLM has set up an *inter-insular division* with headquarters in Batavia, which operates a large route network in Indonesia.

● During 1947, KLM's payroll increased from 6,627 to some 11,000, including 345 pilots. KLM took over 1,500 employees of KNILM when the East Indies company was incorporated into KLM.

● The U.S. occupational authorities in Germany are at present working out plans for the operation of air services between *Frankfurt-on-Main, Stuttgart, Munich and Nuremberg*, and other cities in the U.S. Zone.

● *British South American Airways Corp.* pays the Ministry of Civil Aviation £2,000 annually for the hire of each of its Avro "Lancastrians."

● *British European Airways Corp.* had a deficit of £2,157,937 for its first eight months of operations (August, 1946, to March, 1947). For the twelve months ended March 31st, 1947, *British Overseas Airways Corp.* had a deficit of £8,076,844. These heavy losses are likely to result in administrative consolidations, simultaneously involving the third British airline corporation, *British South American Airways Corp.* It is possible that the old name of *British Airways* will be revived, the corporations acting as divisions.

● ATLANTIC : *Panair do Brasil* has opened a *Rio de Janeiro—Recife—Dakar—Lisbon—Rome—Istanbul* service. Like the company's services from Rio de Janeiro to Paris and London via Recife, Dakar and Lisbon, the new route is also operated weekly with Lockheed "Constellations."

● *Trans World Airline* has ordered 12 new Lockheed L-749 "Constellations" (each with 20 sleeping berths) from Lockheed Aircraft Corp. for $15,000,000, bringing its "Constellation" fleet to 34 aircraft. The new airliners will enable TWA to compete with PAA in offering non-stop flights to Europe with sleeping accommodation. TWA will receive its first Model 749 in February and the last in June.

● On December 10th, *Pan American Airways* lowered its supplement for trans-Atlantic sleeper accommodation from $125 to $100.

● On March 17th, the Irish *Aerlinte Eireann Teoranta* will open a *thrice-weekly trans-Atlantic service* with Lockheed "Constellations." Two of the flights will make an intermediate landing at Boston whilst the third will go direct to New York.

● The Portuguese Government has granted 13,500,000 escudos for the development of the airport on *Sal Island*, in the Cape Verde group, so as to make it into an *international airport*. The facility is to be opened to traffic in the first quarter of the year, co-incident with which a Portuguese service from Lisbon to Rio de Janeiro will be opened.

● On November 1st, 1947, there were *102 all-cargo aircraft* in use by all airline companies in the United States, including non-scheduled carriers.

● The Civil Aeronautics Board is reportedly considering new methods of making *mail payments* (which amount to some $45,000,000 annually) to scheduled airlines. The present system of treating each case individually may be replaced by a standardised method of assessment.

● *United Air Lines* and *Eastern Air Lines* have collaborated in a manner which is unusual for U.S. domestic carriers. During the summer season EAL lent UAL seven of its Douglas DC-4's ; now, in view of EAL's traffic increase for the winter season (to Florida in particular), UAL has lent EAL some of its booking personnel.

● *Scandinavian Airlines System* has decided to intensify its service to *South America* to two round flights weekly in the spring.

AIRLINE PERSONALITIES

● *James M. Landis* was not re-appointed as Chairman of the Civil Aeronautics Board when his term of office expired on December 31st, 1947. He had held the post since June, 1946.

● *Charles J. Stanton*, who recently resigned from the Civil Aeronautics Administration, has been appointed Head of the Brazilian Aeronautical Institute's School of Air Commerce at San José dos Campos, near Sao Paulo.

SERVICE AVIATION

● Air Marshal George Jones, Chief of Staff of the *Royal Australian Air Force*, has announced that the R.A.A.F. will make training flights to England and the U.S.A. during 1948.

● An agreement between the *Belgian and Dutch Air Forces* permits military aircraft of both countries to fly over the other, for training purposes.

● On December 15th, Representative Chester Merrow (Republican) introduced a bill in the House of Representatives to give the USAF annual credits of $6,000,000,000,000 to achieve and maintain the Air Force's equipment of 70 groups.

● On December 29th, the *USAF* announced that its 94th "Hat-in-the-Ring" fighter squadron, equipped with Lockheed P-80B "Shooting Star" jet fighters, had arrived at Ladd Field, Fairbanks, Alaska, for a six-month period of operational training. This is the first large-scale use of jet aircraft for practical purposes in the Arctic zone and the machines were specially "winterised" by Lockheed Corp.

● The USAF's Alaskan Air Command opened an *Artic Polar Indoctrination School* at Nome on December 1st, 1947, to teach survival methods in the Arctic Zone.

● Brigadier-General Earl S. Hoag has been appointed to head a *USAF mission to Turkey*, where it will supervise the equipment of the Turkish Air Force with American aircraft.

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